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ENGINEERING MAGAZINE

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JINGOISM, OR WAR UPON DOMESTIC INDUSTRY.

By Edward Atkinson.

A DEFINITION of Jingoism has often been called for. What better one can be given than the following statement?

It is the expression of aggressive interference in questions with which this country has no direct concern. It is an incitement to violent interference before the facts governing the case are or can be known, and before the respective rights of the parties in contention have been established. It is the promotion of animosity tending to lead to war before any cause has been shown which could justify the officials themselves who may for the time have the power to threaten such a terrible alternative. Jingoism is customarily the resort of weak minds in their effort to attain personal notoriety; but its causes are deep-seated, and it has perverted the minds of men in high position.

It is not the purpose of the writer to deal with the details of the pending contention in regard to the boundary between British Guiana and Venezuela. In the message of the president and the accompanying documents which exposed the credit and the business of this country to a most severe shock it is admitted:

(1) That, if this dispute about the title to a certain area of territory in South America were settled by the parties themselves, either for money or for any other consideration, it would not concern the United States;

(2) In the proposal to appoint a commission it is also admitted that it is necessary to establish the facts and to determine the rights in the case, and that the executive department of our government is not now informed upon the facts, and is therefore without information which would justify any positive action.

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Yet, in spite of this admitted ignorance of the facts necessary to a decision in order to justify any action whatever, the country has been suddenly brought to a great danger by threat of interference, by force or war, in this petty contention. Such a war between the two great branches of the English-speaking people would be dishonor and disgrace to both. Upon them now rests the defence of personal liberty, of the equal rights of mankind, and of equal opportunities for men to establish their own institutions and their own forms of constitutional government. These were the purposes to which the Monroe doctrine was directed with the assent of Great Britain. A war between the English-speaking people would give the opportunity to dynastic powers to attack the very principles which they have always regarded with dread, but which they have not dared to attack so long as their conservators were united in their support. Such a war would be a war upon humanity, reversing the progress of civilization,—a betrayal of trust by the English-speaking people who have carried the principle of personal liberty over great continents and who are charged with the duty of maintaining it.

But whether or not the two propositions which have been submitted are well grounded; whether or not the conditions may be somewhat different from those which now appear to be true, so far as they are disclosed by official documents,—can any one conceive of such incapacity on the part of the officials either of this country or of Great Britain as to render a war even remotely possible upon such a petty issue? What wonder that after the first vacant ravings of the jingo faction had become exhausted the masses of this country should have aroused themselves from a state of shuddering horror that such a crime against the principle of personal liberty could have become possible! They have spoken, and they are now exerting their commanding power in order to remove the causes of the danger to which they have been so ruthlessly exposed.

In the previous lesser contest in which all citizens of repute, without distinction of party, were engaged for the suppression of the jingo faction, before this great danger had aroused the country, it was sometimes urged, by men who now occupy, without filling, a few places of public trust, that the honor of the country should not be weighed against mere dollars and cents. That might be admitted; but what we have now to do is to compute the cost of the possible dishonor of the country.

How necessary it may be to count this cost and to provide for it is witnessed by the second message of the president, following immediately after the first. This first message brought to utter confusion all previous plans for remedying the evils of bad money and bad methods

of taxation. In this second message the president urges congress to provide the means for meeting the new dangers, and to enact measures for diminishing the evil influence of the war upon domestic industry which is the necessary result of Jingoism, that evil influence exerting itself in greater or less measure according to the source from which it emanates.

A great wrong has been committed, which it is too late to remedy; but yet greater wrong may still be prevented. The paralysis of industry which had been brought upon us by the advocates of the free coinage of silver had been surmounted. The necessity for maintaining the lawful unit of value of the nation had been admitted and accepted without further contest. The danger of the forced loan for the continued purchase of silver bullion had been removed by a repeal of the Sherman act. The deficiency of revenue which originated in the repeal of the revenue duties on sugar in the act of 1890 had been nearly overcome. A revenue equal to the expenditures in the next calendar year had become assured, provided normal conditions had been maintained. Finally, the production of iron, which is the surest standard by which to measure prospective progress and which is the indicator of constructive energy and of renewed prosperity, had reached a magnitude never known before. All the physical and material conditions of the country were ripe for activity and welfare.

All these favorable anticipations were suddenly changed to conditions of danger, distrust, and discredit.

This wrong lies at the door of those who would promote war without the justification of self-defence. Hence arises the necessity for counting the cost and declaring the price which we have paid, or must pay if a jingo policy should become the practice of this country.

We will now deal with facts which cannot be gainsaid. Before doing so, let it be remembered that the subtle influence of Jingoism has long been in action. Almost without knowing how the revenue of the country was being expended, we one day learned that two naval vessels had been provided at a cost of many million dollars, which are known as "commerce destroyers." These ships are useless for defence, and are useless for attack upon any vessels except those which bear the surplus products, mostly from our farms, to the use and benefit of our principal customers who pay us for them. These vessels are to be devoted, if used at all, to the plundering of private property, which would disgrace an officer of the army upon land, but which will be imposed as a duty upon the officers of the navy. Yet such acts of war would be but a part of the war upon our own domestic industry which is the necessary result of the jingo policy. This proposed attack, which would be first directed upon the domestic industry of the farmer,

is indirectly as serious a war upon our domestic manufacturers, whose great market is among the farmers. If the farmers cannot sell their crops at a profit, they cannot buy the goods made in our factories or the wares made in our workshops. *The profit depends upon an open export demand for their surplus products.*

The proportion of persons occupied in agriculture in 1890 was rather less than in 1880, but it still constituted a fraction under forty per cent. of all who are occupied in gainful pursuits. The same error undoubtedly existed in the last census that Commissioner Walker pointed out in the census of 1880. A large number of persons who are classified as laborers under the head of personal service are occupied wholly or during a part of each year in agriculture. There is also a very large class listed in the census as occupied in manufacturing, whose work consists in converting the crude products of the farm into the secondary form in which they can be moved long distances or exported. This transfer by occupation can only be estimated, but no one who is accustomed to dealing with statistics can fail to reach the conclusion that substantially one-half of the whole number of persons who were occupied for gain in 1890, numbering a little under 23,000,000, or one in each 2.75 of our population, depended upon a market for the products of the farm, the dairy, the meat-packing and -canning industry, the milling of grain, and upon the various branches of converting crude farm products into the secondary form for sale as agricultural products. Upon the prosperity of this great productive class of 11,500,000 rests that of the manufacturers, the merchants, the traders, the railways, and the inland water ways of the country.

The prosperity of all who deal directly or indirectly with farm products depends upon finding an open market for the sale of the excess of the food and fibres which could not be consumed in this country. That principal market is found in the United Kingdom of Great Britain, Germany, France, Belgium, and the Netherlands, and these countries are the only ones whose ocean-borne commerce is of any considerable importance,—the only ones upon whose traffic our basely-minded commerce destroyers could work the malignant destruction. Witness the facts.

In the ten years from 1885 to 1894 inclusive the exports of the domestic products of this country possessed a value of a little under eight billions of dollars ($7,943,346,945). Of this sum a little under six billions ($5,886,829,343) consisted of the products of agriculture. In the same period the imports for which those exports were exchanged amounted to a little under seven and a half billions ($7,348,396,601). The difference, about six hundred millions in gold ($600,000,000), was placed at our credit in gold coin in the banks of Europe.

Three-fourths of our exports, nearly six billions in value ($5,869,669,581), consisting of more than three-fourths of the products of agriculture, were sold to Great Britain, France, Germany, Belgium, and Holland. The imports from these countries were valued at a little under three and a half billions ($3,344,541,518), constituting but forty-five per cent. of our imports. The difference, amounting to two and a half billions ($2,525,128,063), was passed to our credit in gold coin in European banks, subject to our drafts. We drew against that deposit for our purchases of tea, coffee, sugar, dye stuffs, and other products of tropical and semi tropical countries, which are mainly silver-standard countries, for about three-fourths of this sum, and, so far as gold possessed an increasing power of purchase as compared to silver, we gained that benefit in the increased quantity of goods thus secured.

The exact facts of our export and import traffic with these specific countries will be found below:

	Exports.	Imports.
Holland	251,467,828	115,880,861
Belgium	275,801,834	95,921,479
France	528,776,130	675,934,578
Germany	753,488,170	817,868,418
	1,809,533,962	1,705,605,336
Great Britain	4,060,135,619	1,638,936,182
	5,869,669,581	3,344,541,518
Balance credit in gold coin		2,525,128,063
	$5,868,669,581	$5,869,669,581

It will be remarked that our traffic with Holland, Belgium, France, and Germany placed at our credit a fraction over one hundred million dollars ($100,000,000), while our traffic with Great Britain, against which the brutal fulminations of the jingoists are chiefly directed, placed at our credit over twenty-four hundred million dollars ($2,400,000,000).

But even this table does not show the complete interdependence of the English-speaking people or the mutual service which they render to each other.

Our exports to the British colonies and their dependencies—Australia, to which we export twice what we import; Canada, to which we export more than we import; India, Hongkong, Africa, Honduras, and Guiana—in the ten years 1885 to 1894 inclusive exceeded seven hundred million dollars ($700,000,000). Our imports from all these colonies—the excess being over exports in the last six named—came to a fraction under eight hundred and thirty million dollars ($830,000,000).

The value of our commerce with the machine-using nations of the world and the British colonies, as compared to all others, is as follows:

	Per cent.	Exports to.	Imports from.	Per cent.
Great Britain and her colonies.....	60.	4,765,830,100	2,468,475,746	33.60
Holland, Belgium, France, and Germany.....	22.79	1,809,533,962	1,705,605,336	23.22
	82.79	6,575,364,062	4,174,081,082	56.82
All other countries.....	17.21	1,367,982,873	3,172,315,519	43.18
	100.		7,346,396,601	100.
Merchandise balance....			596,950,334	
		$7,943,346,935	$7,943,346,935	

These figures are very significant. Sixty per cent. of our exports, consisting in by far the largest measure of farm products, are bought of us on a gold basis by Great Britain and her colonies. A fraction under twenty-three per cent., also consisting in largest measure of farm products, are bought by France, Germany, Belgium, and Holland. Seventeen per cent., consisting in much larger measure of manufactured goods than of farm products, are bought by all other countries, and that branch of our traffic is very rapidly increasing, since the virtual control of the iron and steel manufacture has passed to this country.

It may be remarked that, with the development during the last ten years of the "basic" steel, so-called, and the increase in its production in Germany, coupled with the conditions under which this country has assumed the paramount position in the world in the production of iron and steel, the exports of manufactures from Germany and this country have rapidly increased. In point of fact, the control of iron and steel, with an excess of fuel, is bringing this country rapidly to the leading position in supplying machine-made fabrics to all nations.

In respect to our imports, a fraction under thirty-four per cent. are supplied by Great Britain and her colonies, of whom we are the largest single customer, and a fraction over twenty-three per cent. by France, Germany, Holland, and Belgium,—making in all fifty-seven per cent. of the whole, the remaining forty-three per cent. being supplied by other countries. These imports consisted chiefly of tea, coffee, sugar, and other tropical and semi-tropical products. Without going into minute details, it appears, therefore, that ninety per cent. of our entire exports are bought by the gold-standard countries of the world, while fifty per cent. of our imports come from silver-standard countries, or from States which are yet worse afflicted with a depre-

ciated paper currency. The balance of the trade with the gold-standard countries amounts to twenty-five hundred million dollars ($2,500,000,000). It thus appears that an average of two hundred and fifty million dollars ($250,000,000) a year has been placed at our credit each year for ten years in pounds sterling in the banking centers of the world, mainly in London. Yet in that ten years we have been tampering with our standard of value; we have been exposed to the danger of the silver craze and to the debasement of our standard of value to the fluctuating and lessening unit of silver; and, by the way of a combination of jingoists, Populists, and the advocates of taxes upon imports up to the prohibitory point for the purpose of isolating this country, we have been brought into our present condition of distress, discredit, and dishonor.*

These figures of our foreign commerce, upon which the prosperity of our domestic industry rests, bring one fact into most conspicuous notice.

The English-speaking people are the conservators of personal liberty,—of equal rights and of equal opportunity. These foundations of moral and material welfare have been established in this country as well as in Great Britain and her colonies upon the basis of the common law under constitutional forms of government. Wherever the English-speaking people govern, or where they control the government and protect the people of many races, a just administration of the law is assured, and every effort is made to promote the common welfare of all alike. It is nearly a century since Great Britain gave up the effort to control the colonies of America, of Ireland, and of her dependencies in many parts of the world under the former medieval idea that all such possessions should be governed for the sole purpose of promoting the welfare of the British islands; yet the animosity which was rightly caused by those efforts has been continued and has been promoted by the jingo element in this country for two generations since the cause was removed. The English speaking people of this country are called upon even now to meet the same difficulties in dealing with different races of men and with varying conditions growing out of the former state of society that are met by the people of Great Britain in India and elsewhere; yet slowly and surely the right method is evolved, material and political progress are assured, and the credit of the English-speaking nations and States, on which moral as well as material welfare rests, is being finally and firmly established.

No surer evidence of these facts could be cited than the foregoing

* See *North American Review* for February, 1896, on "Future Production of Gold."

statistics of commerce, proving the interdependence of the respective countries and measuring the mutual service which they render to each other in due proportion to their control of modern invention and mechanism,—in due proportion to the justice of their rule,—in due proportion to the credit of their monetary system,—in due proportion to their respect for law,—and in due proportion to their freedom from dynastic oppression and from centralized methods of government,—thus giving a lesson in statistics of the utmost value. The figures appear to measure merely dollars and cents, but to him who can read between the lines they convey evidence of progress in material, mental, and political welfare alike.

It is not often justifiable or judicious to use severe terms in public discussion, but, when the occasion comes, he who spares an enemy deserves himself defeat. The jingoists of our time are public enemies, who promote unreasoning aggression and violence in ignorance of the facts that in our intercourse with other nations they would bring upon us what one of the greatest generals of the civil war by which the jingoists of slavery were quelled rightly named "The Hell of War" without the justification of self-defence.

This treatise has been completed on Christmas Day. May God grant that, when it is printed, peace may have been assured, and that, by the united force of public opinion among the masses of the English-speaking people, the jingo classes will have been compelled to retire from public view in contempt.

"Of what avail are plough and sail,
Or land, or life—if freedom fail?"

Even while the foregoing portion of this treatise was being put in type there has been a profound and wide-spread movement in this country on the part of masters of international law, of merchants, of manufacturers and bankers, of the clergy, and of the trades unions and other labor organizations, forbidding war among the English-speaking people, and demanding that the vague terms of the Monroe doctrine shall be put into a definite form by the representatives of Great Britain and the United States, with whom it jointly originated. The moral sense of the nation has been aroused, and this decree has been uttered in terms that no congress can disregard and no executive can resist. There is every reason to believe that corresponding action has been taken in Great Britain. The time is, therefore, at hand when the masses of the English-speaking people, coöperating through their appointed agents, may suppress the jingo classes in both countries, and may bring moral forces into action which will forever assure peace, order, and industry among them. Their material interests as well as

their moral and political welfare are at stake. The future prosperity of the western farmer, of the southern cotton-grower, and of the eastern manufacturer and mechanic alike depend upon present action.

Is there not something grotesque in the total inconsistency between the precepts which have been so long put before us and our present practice in our relations with Great Britain? In practice we spend huge sums of money to improve our railways and to enlarge our canals. We ask for great appropriations to improve our rivers and harbors. Every city upon our coast is trying to devise methods for enlarging its docks. All this work is done to promote and secure a foreign market for the excess of our farm products, and to open the way for commerce with other nations, of which sixty per cent. is with British possessions. We are striving to do away with every physical obstruction that can impede the exchange of products, in order to secure our part of the mutual benefit of the nations which share therein.

The greater part of this commerce consists in supplying the machine-using nations, with whom we compete in manufacturing, with food, metal, timber, and fibres, because we find that our commerce with such nations is greater than with all the rest of the world, and that the benefit corresponds. Having exhausted all our efforts on these lines, we are then assured by the jingoist that our chief customers are waging an aggressive war on our domestic industry. We are told that the maintenance of a single, true, just monetary standard is adverse to our "great silver interests," and therefore detrimental to this country, the average annual product of this "great silver interest" being about a third of the value of the hens' eggs annually produced in our barnyards.

We are told that the honor of this country depends upon defending the title claimed by a South American republic to a piece of malarious tropical land in South America, in disregard of the fact that the system of voting in that republic is usually conducted with bullets, and not with ballots. We are threatened with war with our own kindred beyond the sea in documents uttered by the government officers, in which their own ignorance of the facts of the case is admitted by asking for a commission to determine the facts. This case has been most fitly described by one of the ablest members of the bar as being characterized by "bad law, bad morals, and bad manners."

Yet perhaps no surer method could have been devised to bring about a final removal of all the prejudices which exist among the masses of the English-speaking people at the present time than this effort of the jingo classes to promote continued animosity. The recent shock to the public conscience will end in a concentration of the moral forces and the material interests of the people of the United States and of Great

Britain for the purpose of assuring permanent peace and order among them. Already a definite movement is well under way for the organization of an international union whose objects may be thus briefly summarized:

(1) Any international question of title to land shall be adjudicated by judges learned in international law,—precisely as all other questions of land title are adjudicated.

(2) Any question of international damages shall be referred to arbitration.

(3) Private property upon the seas, other than contraband of war, shall be exempt from seizure.

(4) Privateering shall be abolished.

(5) No city adjacent to a fortified harbor, which is not itself made part of the harbor defence and defended by arms, shall be bombarded.

(6) Measures shall be taken to maintain the rights of lesser States.

(7) Measures shall be taken to sustain organized governments by mutual agreement in isolated places, like the Sandwich Islands and Samoa, and to neutralize them as free ports.

(8) General measures shall be defined for the maintenance of peace.

(9) Measures shall be taken for abating the evils of war, and to bring into this Union for Peace as many other States and nations as may be induced to join it, especially in South and Central America, to the end that the common purpose of England and the United States, which has been partially formulated under the name of the Monroe doctrine, may be defined and safely and surely applied.

Many improvements may be suggested for such a declaration of the present purpose of the masses of the people of this country and of Great Britain, and in the progress of their discussion a way will surely be found to give them effect.

TRADE AND INDUSTRY OF SOUTH AMERICA.

By Emilio M. Amores.

THE sixteen republics south of the United States, which include Mexico and the countries of Central America, have a population of over fifty millions of progressive people inhabiting a territory of 8,500,000 square miles extending from Rio Grande to Patagonia and endowed by nature with resources and wealth of surpassing magnitude.

The government and institutions of these countries are very similar to those of the United States. In every one of the countries of South America, ever since their establishment, there has always been a strong leaning, both on the part of the governments and the people, toward the United States, the great republic in the northern half of the continent, after whose model they are patterned. They desire a more free and intimate intercourse with us; yet the volume of our commerce with Latin America is but a shadow compared with what it might be if only a practical effort were made to supply its markets. The geographical position of the South American countries, Cuba, and the rest of the West Indies, make them naturally the first foreign markets for American manufactured products. They naturally look up to this great and enterprising republic as the purveyor of those useful articles which are of prime necessity in every civilized community. In the United States everything that South American nations require can be manufactured, in factories already established, as well and as economically as anywhere in the world. Yet we enjoy but a small percentage of that profitable trade. The people do not use our language, but this is no obstacle; the country supplying the greater part of the wants of that market uses the English language, and the country of least importance in that market is Spain, the mother-country of the South Americans.

In 1860 the trade of the United States, Great Britain, and France, with Mexico, Central and South America, and the West Indies, stood about as follows: the southern countries imported from the three manufacturing nations mentioned merchandise valued at $203,283,201, and exported to the United States, England, and France merchandise valued at $215,985,435. Of the imports there were taken from the United States $44,978,676; from France, $70,319,822; from England, $87,984,703. Of the exports the United States took $79,109,332; France, $35,156,730; Great Britain, $101,719,373.

In twenty-nine years, or from 1860 to 1889, our imports from

South American countries have increased $126,275,057, or, roughly, 150 per cent. During this period the imports of Great Britain from South America have decreased $12,234,865, or about 12 per cent. On the other hand, the exports of manufactured goods from Great Britain to South America have increased in value over $89,000,000, or over 100 per cent. The value of the exports of the United States to Latin America has likewise doubled, but our export trade is not at all in proportion to our imports from the south. The exports of South America have increased, in the twenty-nine years since 1860, 38 per cent.; the imports, 85 per cent. The commerce of the southern continent rapidly increases with every year, and its possibilities for even the very near future, owing to the great natural resources and the enormous undeveloped mineral wealth of the country, can be but faintly surmised. Greatest of all are the possibilities for American merchants and manufacturers.

The compilation on the next page may be of interest, giving the population according to the last census or estimate. The figures in the year column apply to the commerce of the countries.

A view of the several republics whose territory, resources, and population are greatest and with which the United States have already a considerable trade on a sound basis will give a better idea of the markets and possibilities as a whole.

Brazil, the largest of the southern republics, occupies nearly half of the continent of South America, and claims to have more navigable rivers than any other country in the world. It is situated mainly in the torrid zone, and its climate is generally agreeable. The population is increasing rapidly from immigration. Rio de Janeiro, the chief city, has a population, according to the last municipal census, of nearly 1,000,000 inhabitants. Bahia has 165,000; Pernambuco, 130,000; and there are over fifty cities of 5,000 inhabitants or more. The Roman Catholic church has probably less sway in Brazil than in any other part of Latin America: absolute equality prevails in religion, and education is making rapid advances among the people. The general government maintains a school of mines and a polytechnic school.

Brazil is naturally an agricultural country, and only a small part of its soil has been brought under cultivation. The land is rich in coffee and sugar. The lands suited to the production of the latter article are practically unlimited in extent; the cotton yield is abundant, and the cultivation of the manioc and cocoa is increasing. Rubber is the principal product of the Amazon valley, 33,000,000 pounds having been exported from Pará in 1888.

The forests and mines are of great value, but comparatively little has been done for their development. Iron abounds, as well

			Total Foreign Commerce the year mentioned.			Value of Commerce with the U. S.	Value of Commerce with the U. S.
	Area in Square Miles.	Population, latest estimates.		Imports, dollars.	Exports, dollars.	Imports from U.S. dollars.	Exports to U. S. dollars.
Mexico	767,237	11,632,924	1888–89	40,024 894	60,150,423	13,212 773	23,319,263
Central America							
Guatemala	63,397	1,471.025	1890	7,639,833	14,401,534	1 161.159	2 605.273
Honduras	47,090	450 000	1889–90	1.531,349	2,667.008	1,634,474	860,212
Nicaragua	49,500	315,000	1889–90	3,327,006	2,746,794	1,183,858	1.658,400
Salvador	7,256	800,000	1890	2,401,314	7.578,734	815,329	1.388 560
Costa Rica	23,000	243 205	1891	8.351.029	9.664 607	1,001,104	1,023.983
Brit. Honduras	7,562	31,471	1890	1,829,480	1,866,099	365,897	206 484
Total Central America	197,774	3 310,701		25,080,011	38.924.769	6,161 821	7.742,912
South America							
Colombia	504,773	4.000,000	1890	13,345,792	20.457,855	2,739,347	3 809,953
Venezuela	599,538	2,500,000	1889–90	16,137,581	19,477,048	4 102 306	12,570.317
Brazil	3,251,829	14,000,000	1890	142,514,600	173,530 812	10,848,271	60 620 047
Argentine	1,125,156	4.000 000	1891	67,100,000	96,700,000	11,230 022	5.748,806
Bolivia	784,554	2,333.350	1887	5,720,000	12,260,000	6,661	281
Chili	290,828	3,267.441	1889	65,092,013	65,963,100	5 526.696	2 920.386
Ecuador	248,350	1,272 065	1890	10,010,352	9,761,634	750 972	331.847
Paraguay	88,807	600,000	1890	2,725,612	2,901,589		546.230
Peru	483,747	6,000 000	1887	8.658,531	8,872,287	1.166,765	2.736.678
Uruguay	72,172	750 000	1890	32 364.627	29.085,519	3,566.701	3,561 150
British Guiana	109,000	288,328	1891	8,197 294	12,156,261	2.072.392	562,642
Dutch Guiana	46,060	70 951	1889	1,967.129	1,415 791	254,384	8,680
French Guiana	30,463	26,605	1889	1.727.543	824.496	142,162	
Continent South America	7,635,282	36,608,840		375.065 074	453 406 390	42,396,679	93,317,251
Mex., Central & South America	8,600,293	51 552 465		430,169.979	553.489 582	68,781,173	114.379 426
Cuba	45,883	1,631,687	1891	52,954.582	99 407,902	12,038,046	56,336.064
Puerto Rico	3,550	813.937	1890	18.230.384	10,710 519	2,232 637	4,865,970
Haiti	10,204	960,000	1890–91	10,060 979	14 165,779	4.051.981	3,737.849
Santo Domingo	18,045	610,000	1890	2,406,769	3.895.109	1 150.294	1.743,277
British W. Indies	18,428	1,373,218	1890	32.405 328	31,053 849	8,362,395	15 237,984
Danish W. Indies	118	36 450		no data	no data	752 946	674 939
Dutch W. Indies	403	45,799	1889	1,383 486	269,168	728,097	228.773
French W. Indies	965	341,762		9,892,954	9.380.343	1.816 989	180 341
Total W. Indies	97,596	5,812,853		127 334 483	168,882,669	31,133,385	93.005 197
Grand Total	8,677,889	57.365,308		557,504,462	722,364,251	99,814,558	207,384,623

as copper, manganese, and lead. There are about 17,000,000 head of cattle. In 1888 there were 90 cotton mills running, and the number was increasing. In 1889 there were about 6,500 miles of railway, and 5,000 miles projected. The telegraph system is under government control, and in 1890 there were 12,467 miles of wire. Brazil has telegraphic communication with the United States by three lines: with Montevideo, thence across to the Pacific coast, and thence by the Isthmus to Galveston; by the Western and Brazilian cable to Europe, and thence to New York; by the French cable, *via* West Indies, to Florida.

The commerce of Brazil is principally with Great Britain, France, and the United States, and the principal articles of import are cotton goods, wines and spirits, preserved meats and fish, woolen goods, machinery and manufactures of iron and steel, coal, and manufactures of leather. The exports are principally coffee, hides, tobacco, gold coin and bullion, sugar, diamonds, rubber, cocoa, and rosewood. How small is the share of trade falling to the United States from South America may be seen from the figures relating to the commerce of Brazil in 1890. In that year Brazil imported manufactured articles from Great Britain to the value of $36,297,413; from France, $15,635,066; and from the United States, $11,902,496. On the other hand, the United States took of Brazil's exports $59,318,756; France, $24,215,788; and Great Britain, $21,172,560. Great Britain sent to Brazil in 1890: cottons, $14,200,000; wrought and unwrought iron, $5,100,000; machinery, $3,200,000; woolens, $1,662,000; leather, $1,262,000. France sent: manufactures of leather, $1,190,420 (a falling off of over one half from the three years preceding); woolens, $1,105,021; cottons, $834,440.

In many quarters at the present time Venezuela is regarded as "an insignificant South American country!" "What is it?" "Of what interest is it to us?"

Venezuela is three times the size of France and of Germany, five times the size of Italy, and, larger than any of the European nations, excepting Russia. There are only two seasons in Venezuela,—summer and winter. The first is dry, and the latter rainy; but the trees retain their verdure and produce the entire year, as if it were perpetual spring. The climate is varied. On the coast it is hot, but there are never-failing sea breezes, and on the highlands it is cool and delightful; and there are localities where the mountains are perpetually covered with snow. Although Venezuela is situated in the tropic zone, the temperature does not rise as high as in the corresponding latitudes of Africa. The average heat reaches 80° on the coasts, and the highest temperature felt on the highlands is 71°.

It has a coast line of 1,876 miles, indented by five gulfs, and has fifty inlets and thirty-two ports, besides numerous anchorages. It is bounded on the north by the Caribbean sea and the Atlantic ocean; on the south by the republic of Brazil, and territory in dispute between Colombia, Ecuador, and Peru; on the west by Colombia; and on the east by British Guiana.

Its population is small. The country is traversed by 1,047 rivers, the longest of all being the Orinoco, one of the greatest in the world. Its length is 1,475 miles, almost entirely navigable, and in some places it is 12 miles wide. Its narrowest part is in front of

Bolivar City, where it measures 3,000 feet,—one fourth its average width. The Orinoco has 436 tributaries, rendering navigation to the neighboring republic of Colombia easy; and the branch called the Casiquiare unites it with the River Negro, a great tributary to the Amazon, so that from the mouth of the Orinoco on the Atlantic there is established the extensive water communication which crosses Venezuela, Colombia, Ecuador, Bolivia, and Peru, and which reaches as far as Brazil.

As far as natural resources go, Venezuela is one of the richest of the South American republics, for, although its territory is crossed by three mountain systems, their configuration is such that communication between the plains and valleys is very easy. The greatest wealth is agricultural. The two chief products are coffee and cocoa. Besides these, there are sugar cane, bananas, cotton, indigo, cocoanuts, Indian corn and rice, wheat, barley, etc.

The wooded belt is situated near the Orinoco and contains very rich gold mines. In this belt thrive without cultivation caoutchouc, sarsaparilla, divi-divi, tonka bean, and copaiba. Nature has been lavish in her endowments. In addition to the almost endless variety of rare and precious woods, cereals, and fruits, the country is extremely rich in valuable mines yet undeveloped and open for investments.

Venezuela has largely increased its commerce with the United States during the last decade. In 1880 the exports to this country amounted to $6,040,000, and the imports from this country amounted to $2,270,000. In 1889 the exports to the United States amounted to more than $10,000,000, and the imports to $5,000,000. This is more than Venezuela annually sells to and buys from Europe.

The articles principally in demand in Venezuela are breadstuffs, carriages, carts and cars, coal, cottons, earthen, china and glass ware, fancy articles, manufactures of flax and hemp, gunpowder and explosives, iron and steel manufactures, leather goods, manufactures of wood and wool, paper and stationery, meat, and dairy products. Foreigners are treated well, Americans being especially welcome. The population is increasing rapidly, and there is no country in South America more desirous of extending its relations with the United States than this free republic, with its vast undeveloped resources.

In the Argentine Republic the population is rapidly increasing, owing to immigration. The capital, Buenos Ayres, had a population of 177,790 in 1869, 295,000 in 1882, and 538,385, including suburbs, in November, 1889.

The country extends from latitude 21° to 55° south, a distance of 2,400 miles, and its average breadth is 700 miles. The climate is

temperate; we might say that it occupies a place on the southern continent corresponding in climate to that of the United States in the northern. The soil is fertile, valuable forests lie along the river banks, and millions of sheep and cattle roam over the plains. Agriculture has made rapid advancements, and is now one of the greatest sources of the country's wealth. In 1889 the land under cultivation had grown from 825,492 acres in 1875 to 5,899,859 acres, and this is estimated at not more than one per cent. of the total area of the country.

The principal products are wool, hides, skins, wheat, maize, hay, linseed, flour, jerked beef, bran, bones and bone ash, frozen sheep carcasses, hair, sugar, wine, grease, and tallow. Cattle- and sheep-raising is the most important industry, and animal products constitute the chief articles of export.

As in Brazil, some advance has been made in the direction of manufacturing, particularly in textiles, and only a few years ago a well-equipped knitting factory was established in Buenos Ayres.

Mining is an important industry, silver, copper, tin, bismuth, and, in small quantities, bromid of lime being found.

There were 7,676 miles of railway in 1892, connecting the principal towns with the capital. There were, in addition, 10,285 miles under survey or projected. In 1892 there were 70,415 miles of telegraph.

The commerce is chiefly with Great Britain, France, and the United States. In 1890 the Argentine exported to Great Britain articles valued at $20,097,681 and imported from that country merchandise valued at $40,000,000. Exported to France, $41,426,774; imported from, $19,968,408; exported to the United States, $5,401,697; imported from, $8,322,627.

Chili, extending 2,600 miles along the Pacific coast, is divided into four well-marked belts, mineral, agricultural, forestry, and fishery. In the first are extensive guano deposits on the coasts, and rich nitrate fields in the center; borax and iodine are also found. In both the first and second belts there are many rich mines of gold, silver, and copper. Other mineral productions of Chili are mercury, iron, zinc, manganese, coal, nickel, antimony, arsenic, bismuth, sulphur, and cobalt. An idea of its commerce may be had from a glance at Tables 2 and 3.

What has been said of the foregoing countries may be repeated of Peru and the United States of Colombia, as far as abundant and various yield of the soil and extent of mineral resources are concerned. And indeed, for that matter, the remaining countries of South America—Paraguay, Uruguay, Bolivia, Ecuador, and the republics of Cen-

PRINCIPAL DESTINATION OF THE EXPORTS OF LATIN AMERICA.

(From Bureau of Statistics, Report of Treasury Department.)

Countries from which imported.	Imports into—in dollars.				Total, including Spain, Italy, Belgium.
	United States	Great Britain	France	Germany	
Mexico	23,319,263	2,267,759	1,655,389	2,569,686	29,956,695
Central America	7,742,912	7,048,763	1,177,142	3,914,148	21,345,119
Cuba	56,336,664	508,486	3,668,016	3,869,404	74,284,932
Puerto Rico	4,865,970				4,865,970
West Indies	21,803,163	11,049,256	21,172,100	6,289,150	61,488,026
South America:					
Guianas	4,132,472	6,130,374			10,312,987
Colombia	3,809,953	1,193,704	4,564,400	1,193,570	
Venezuela	12,470,317	1,385,327	6,821,254	688,296	
Brazil	60,620,047	24,676,211	26,179,203	29,164,996	
Uruguay	2,736,678	2,192,509	7,825,047	933,436	
Paraguay				28,560	
Argentine	5,748,806	9,811,749	42,603,067	20,407,310	374,267,306
Chili	2,920,386	15,887,044	1,614,287	14,620,816	
Bolivia	281		508,499	574,532	
Peru	331,847	6,297,136	8,670,831	1,593,886	
Ecuador	546,230	352,480	556,542	665,924	
Falkland Islands		693,710			
Total	207,384,389	89,484,508	127,015,687	86,513,714	576,521,037

PRINCIPAL SOURCES OF IMPORTS OF LATIN AMERICA.

Countries from which exported.	Exports from—in dollars.				Total, including Spain, Italy, and Belgium.
	United States	Great Britain	France	Germany	
Mexico	13,212,773	7,889,112	10,769,400	3,462,424	37,564,689
Central America	4,795,924	5,085,011	398,800	1,739,304	14,316,574
Cuba					52,627,957
and Puerto Rico	14,270,683	13,466,360	2,296,700	1,659,336	42,401,827
West Indies	16,862,684	15,100,013	7,777,900	1,314,474	
South America:					8,751,547
Guianas	2,468,938	4,775,983	1,505,400		
Colombia	2,729,347	5,974,116	8,260,400	999,874	
Venezuela	4,102,306	3,905,751	1,891,400	2,194,598	
Brazil	10,848,271	32,840,573	18,952,600	13,477,230	
Uruguay	3,566,701	12,028,615	8,878,000	3,312,484	
Paraguay				43,554	350,143,171
Argentine	11,230,022	53,033,608	43,116,200	14,851,676	
Chili	5,526,696	15,718,615	3,821,400	6,995,534	
Bolivia	6,661		57,900	241,808	
Peru	1,166,765	5,225,108	1,814,200	1,631,014	
Ecuador	750,972	1,351,919	501,800	414,596	
Falkland Islands		185,287			
Total	90,804,640	177,241,778	109,952,100	52,237,906	505,868,165

tral America—are all rich fields, open and waiting for the enterprise of American merchants and the implements and articles of American manufacture, and promise abundant return for the investment of American capital. The mining interests in every one of the States south of us offer the greatest of opportunities to American capital, genius, and skill.

In Ecuador there is a good field for the lucrative employment of capital in mining, but, as the Bureau of American Republics reported in one of its bulletins, "mining is in a very backward condition, only a few mines being worked by an English gold mining company."

Mexico has been lavishly endowed by nature with mineral resources. For nearly four hundred years mining has been carried on there, and in all this time fabulous quantities of precious metals have been extracted, but by far the greater part of her mineral wealth yet awaits enterprising and skilful engineers. At the beginning of this century Humboldt estimated the number of mines in Mexico at 3,000. A decade ago there were hardly as many being worked; but, since the extension of the railroad systems, many more have made their appearance, and the value of their products has greatly increased. Mining has made much greater progress in Mexico than in any of the other Latin-American countries. One reason for this, of course, is that the population of the country is so much greater, and the means of transportation and communication with investing countries are more nearly adequate. The new mining laws that went into effect in 1887 looked to the encouragement of coal, mercury, and iron mining, which had been, and are still, neglected.

In an interesting and complete hand-book on Mexico, issued by the Bureau of American Republics, there is the following on the law of June 7, 1887: "All coal, iron, and quicksilver mines are exempted for fifty years from all federal, State, or municipal taxes (excepting the stamp tax). Iron of Mexican origin in bars, ingots, rails, etc., enjoys the same privilege. All mines other than these mentioned are subject to but one tax, which cannot exceed two per cent. of the value of the annual product. The free circulation of gold and silver, in bars or coined, and, in general, of all the products of mines, can not be impeded by any tax whatever. Mercury is exempted from all tax. The tax on reductive works cannot exceed one-fifth of one per cent. of the value of the works. The law also prohibits the State from imposing any tax whatever upon mines, their machinery, products, the capital invested in them, the declarations or denouncements, or any other acts necessary to the acquiring of a mine."

From that time up to a few years ago, it is estimated, over $30,000,000 was invested in mining properties, and, in seventeen months, from April, 1887, 2,077 mines and 33 reduction works were recorded. But the condition of mining in Mexico is more generally known than are the immense possibilities in the other countries of South America, where enterprise and capital have been slow to assert themselves and reap the advantages which nature so freely offers.

In Colombia coal fields are extensive; the country is rich in precious stones; gold and silver deposits are abundant; so is iron; and none of these resources are yet developed.

The chief wealth of Bolivia is its mineral deposits, but insufficient communication has retarded their development. They include gold, silver, a superior quality of copper, tin, lead, bismuth, mercury, platinum, iron, zinc, coal, rock crystal, alum, magnetic ore, talc, emeralds, opals, agate, and alabaster. There are also in Bolivia many kinds of marbles, slates, pumice stone, granite, syenite, porphyry, basalt, chalk, saltpetre, borax, and magnesia in more or less abundance.

EXPORTED TO SOUTH AMERICAN COUNTRIES, 1889.			IMPORTED FROM SOUTH AMERICAN COUNTRIES, 1889.	
Value.	Per cent.		Value.	Per cent.
$177,241,778	35.04	United Kingdom	$ 89,484,508	15.52
109,952,100	21.73	France	127,015,687	22.03
90,804,640	17.95	United States	207,384,389	35.97
52,237,906	10.33	Germany	86,513,714	15.01
33,207,666	6.56	Belgium	44,604,167	7.74
28,774,150	5.69	Spain	15,425,278	2.68
13,649,925	2.76	Italy	6,093,294	1.05
$505,868,165	100.00	Total	$576,521,037	100.00

There is not a country in South America that does not abound in mineral wealth as well as in rich soil and precious woods. Why is it that American investors are not more closely identified with these fields? Why is the balance of trade so much against us? Here is a market of over fifty millions of people at our very doors, so to speak, the people naturally leaning towards us, and desiring greater commercial intercourse with us. Yet their market is now held by Great Britain, Germany, France, Spain, Italy, and Belgium.

The manufacturers of those countries are in no better condition to supply the consumers in Latin America than are those of the United States. It is not assuming too much to say that the South Americans are as different from the nations of Europe in their habits and tastes, and in what they choose to consider their requirements, as from ourselves. If, in these respects, they have anything at all in common with any nations of Europe, those nations are Spain and Portugal. And Spain and Portugal may be said to have no commerce at all with them.

It has been the custom of American manufacturers to export to South America whatever they could not easily dispose of at home. The manufacturers in Europe of cottons, woolens, silks, laces, leather goods, boots and shoes, iron ware, manufactures of wood, machinery, novelties, stationery, and, in fact, everything the people of South

America use, have always adopted different tactics with the markets of South America, and, in fact, with the markets of the world. Their policy is to study the people's tastes and habits, and to make themselves masters in the knowledge of every detail of every requirement.

Having mastered the knowledge of the requirements of the people, they set about meeting them. And they do meet them. They obtained a foot-hold in Latin America, where they continue to hold the markets against all comers. This is particularly true in the case of Great Britain.

It should be unnecessary to give views on the natural advantages that would result, both to the countries south of us and to ourselves, from more intimate trade relations. They are many and obvious. The people of Latin America, not of course including the negroes and native Indians, are an esthetic people. To sell to them we must study their tastes, and throw over our own ideas of what is best. If our practical and generally tall women want common-sense shoes, and the artistic women of the Latin republics want high French-heel shoes, then we must keep our common-sense shoes at home, and make a high-heel shoe with needle points to sell to our dainty sisters in the south.

The first most advisable line of procedure in planning to sell to South America is to have one or more clerks at home who are thoroughly familiar with the Spanish language. And even of more importance is it to send to South America only agents who thoroughly understand the language, having the address and education necessary for intercourse with a people naturally polite and inclined to be diplomatic. No people can be rightly studied unless the student is familiar with their language. One might as well expect to master a special science before becoming acquainted with its nomenclature.

In conclusion, I may say that I am firmly convinced, from my intimate knowledge of the people and countries of South America, that, if the methods described were to be carried out by American manufacturers and capitalists, their success in southern markets would be assured.

GOLD MINING IN THE SOUTHERN STATES.

By H. B. C. Nitze.

DURING the early years of the sixteenth century the published accounts of various Spanish explorers of the New World reported the existence of gold in the southeastern part of what is now the United States; and many traditions are still extant of their discoveries,—for instance, the Brewer mine in South Carolina, where DeSoto is supposed to have mined for gold.

The aboriginal inhabitants of our continent are also credited with having sought after and discovered the yellow metal, and the sites of their ancient workings are still pointed out in the Nacoochee valley of Georgia, and elsewhere.

It is, however, impossible to name the precise date of the first discovery of gold in the United States. In all probability some mining was done previous to the Revolutionary war, but no authentic references to this can be obtained. In 1782 Thomas Jefferson, in his "Notes on Virginia," mentions the discovery of a piece of ore, containing gold, on the Rappahannock river. In 1799 a nugget, weighing seventeen pounds, was accidentally discovered on the plantation of Mr. John Reed in Cabarrus county, North Carolina. The story is current that Mr. Reed, in ignorance of the true nature of the metal, used it as a door-prop until 1802, when he was told that it was gold by a jeweler in Fayetteville, to whom he sold it for three dollars and a half. In 1803 a twenty eight-pound nugget was found in the same locality,—the largest nugget on record in the eastern United States. Regular mining work was commenced shortly afterwards; other discoveries followed; and the date 1804 may be fairly accepted as that of the first real excitement in the gold fields of the southern United States.

The earliest record of a domestic gold deposit in the United States mint was in 1804, and from that year until 1828 (inclusive) North Carolina furnished all the gold produced in this country, amounting to $110,000. During 1829 $2,500 was received from Virginia, and $3,500 from South Carolina. The first returns from Georgia appear in 1830, from Tennessee in 1831, from Alabama in 1840, and from Maryland in 1868.

Below are given several statistical tables, which explain themselves. These figures include, besides the United States mint and assay office receipts, all such bullion as went abroad, or was used directly by local jewelers or otherwise, and represents as nearly as possible the total product of the southern gold mines.

Table I shows the comparative fluctuations in the production for

TABLE I.—GOLD AND SILVER* PRODUCED IN THE SOUTHERN STATES AND DEPOSITED AT THE UNITED STATES MINT AND ASSAY OFFICES FROM 1793 TO 1894 INCLUSIVE.†

Year.	Amount.	Year.	Amount.	Year.	Amount.
1793–1823	$ 47,000	1847	$1,018,079	1871	$ 138,791
1824	5,000	1848	850,692	1872	164,461
1825	17,000	1849	891,968	1873	158,952
1826	20,000	1850	658,605	1874	141,647
1827	21,000	1851	500,539	1875	150,612
1828	46,000	1852	711,449	1876	138,256
1829	140,000	1853	486,184	1877	159,009
1830	460,000	1854	323,489	1878	162,925
1831	519,000	1855	362,349	1879	186,123
1832	678,000	1856	325,820	1880	203,770
1833	868,000	1857	141,810	1881	197,084
1834	898,000	1858	349,323	1882	229,459
1835	686,300	1859	379,677	1883	272,046
1836	667,000	1860	231,398	1884	255,259
1837	282,000	1861	141,778	1885	239,963
1838	358,750	1862	6,298	1886	272,414
1839	429,648	1863	1,624	1887	390,531
1840	427,311	1864	6,093	1888	234,947
1841	544,661	1865	33,345	1889	224,323
1842	723,761	1866	202,000	1890	269,997
1843	1,059,100	1867	106,903	1891	254,707
1844	928,095	1868	155,660	1892	262,023
1845	986,849	1869	191,738	1893	261,904
1846	992,792	1870	168,057	1894	273,072

Total, $25,289,420

TABLE II. ESTIMATE OF THE PRODUCTION OF GOLD AND SILVER IN THE SOUTHERN STATES FROM 1799 TO 1879, AND ANNUALLY SINCE.‡

Years.	Md.	Va.	N. C.	S. C.	Ga.	Ala.	Tenn.	Total.
1799–1879	$2,500	$3,091,700	$19,659,600	$2,587,900	$14,150,500	$365,300	$155,300	$40,042,800
1880....	250	11,500	95,000	15,000	120,000	1,000	1,500	244,250
1881....	500	10,000	115,000	40,000	125,000	1,000	1,750	293,250
1882....	1,000	15,000	215,000	25,000	250,000	3,500	250	509,750
1883....	500	7,000	170,000	57,000	200,000	6,000	750	441,250
1884....	500	2,500	160,500	57,500	137,000	5,000	300	363,300
1885....	2,000	3,500	155,000	13,000	136,000	6,000	300	345,800
1886....	1,000	4,000	178,000	38,000	153,500	4,000	500	379,000
1887....	500	14,600	230,000	50,500	110,500	2,500	500	409,100
1888....	3,500	7,500	139,500	39,200	101,500	5,600	1,100	300,900
1889....	15,962	4,113	150,174	47,085	108,069	2,639	750	316,330
1890....	16,962	6,496	126,397	100,294	101,318	2,170	1,001	354,638
1891....	11,264	6,699	101,477	130,149	80,622	2,245	519	332,975
1892....	1,000	5,002	90,196	123,881	95,251	2,419	1,006	318,755
1893....	114	6,190	70,505	127,991	100,375	6,362	250	311,787
1894....	978	7,643	52,947	98,763	99,095	4,092	389	263,827
Total..	$46,068	$3,265,443	$21,709,276	$3,581,263	$16,101,730	$419,827	$166,105	$45,227,712

* The silver production is so small that for practical purposes it may be overlooked; hence the figures in this table and that following may be applied to gold alone.

† From the reports of the director of the United States mint.

‡ From the production report of the director of the mint, for 1892, and annual reports since.

various years. The early mining, as in all gold regions of the world, was confined to the stream gravel deposits and other shallow placers. The marked decrease in the production during the few years following 1834 may be explained by the partial exhaustion of these more acces-

HYDRAULIC MINING. PARKER MINE, STANLY CO., N. C.

sible virgin placers. It was at this period that attention began to be paid to vein mining, and from 1837 to 1849 there was an enormous increase in the production, with few retrogressions; in the forties the south reached its maximum annual output, approximating $1,000,000. In the early fifties the California excitements distracted the interest from the southern fields, and an era of decreased production set in, which culminated in practical cessation during the civil war. Since then there have been periods of revival and depression, due to many minor causes; of late the annual production has been something over $250,000.

In order to institute a comparison between the present gold production of the southern States and that of the principal gold fields of the world, the following statistical table * is presented, showing the production in the south for 1894 to have been $263,827.

It is thus evident that the south is a very small factor in the gold production of the world, and that, in comparison with the other gold fields of the world, it stands last.

* From the report of the director of the United States mint for 1894.

HVDRAULIC MINING. PARKER MINE, STANLY CO., N. C.

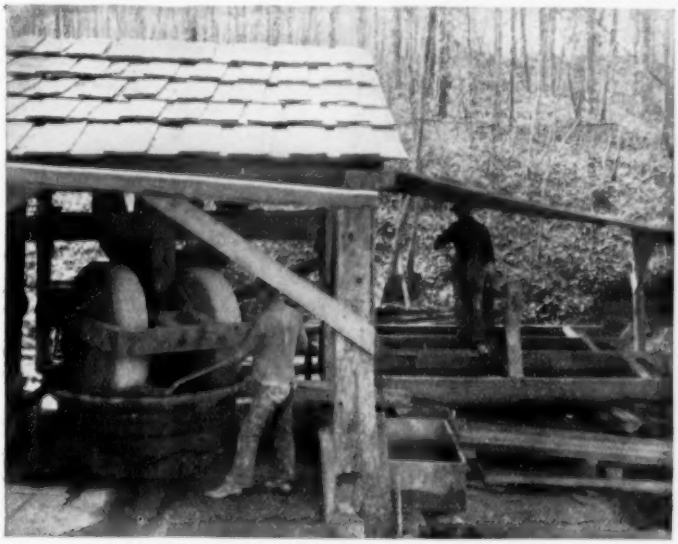
STAND PIPE. PARKER MINE, STANLY CO., N. C.

SLUICES. PARKER MINE, STANLY CO., N. C.

BARNHARDT SHAFT AND EAMES MILL, 1893. GOLD HILL, N.C.

California	$13,570,397	Australasia	$41,760,800
Colorado	9,491,514	Africa	40,271,000
Montana	3,651,410	Russia	24,133,400
South Dakota	3,299,100	China	8,556,800
Idaho	2,081,281	Mexico	4,500,000
Arizona	1,784,475	India	3,986,900
Oregon	1,422,056	U. S. of Colombia	2,892,800
Nevada	1,137,819	Brazil	2 219,500
Alaska	1,118,550	British Guiana	2,310,100
Utah	868,031	French Guiana	1 329,200
New Mexico	567,751	Austria-Hungary	1,684,800
Washington	195,100	Germany	1,498,500
United States, total	39,500,000	Canada	1,042,100
Total of the world			$179,965,600

The gold ores of the southern Appalachian States occur in the Piedmont and Mountain regions throughout the great belt of crystalline and metamorphic rocks stretching in a southwesterly direction from Maryland to Alabama, 600 to 700 miles in length, and 50 to 150 miles in width. This broad area may be subdivided into several minor



CHILIAN MILL AND ROCKERS. NEAR GOLD HILL, N. C.

gold-bearing belts: (1) the Virginia belt; (2) the eastern Carolina belt; (3) the Carolina slate belt; (4) the Carolina igneous belt; (5) the King's Mountain belt; (6) the South Mountain belt; (7) the Georgia belt; (8) the Alabama belt.

The Virginia belt extends from Montgomery county, Md., in a southwesterly direction to the North Carolina line. Its width is from 9 to 20 miles, and the principal mining sections lie in Fauquier, Culpepper, Stafford, Orange, Spottsylvania, Louisa, Fluvanna, Goochland,

THIRTY-STAMP MILL. CATAWBA MINE, N. C.

GENERAL VIEW, CATAWBA MINE, KINGS MOUNTAIN, N. C.

and Buckingham counties. The rocks are gneisses and schists, striking N. 20° to 30° E., with easterly dips.

The eastern Carolina belt comprises an area of about 300 square miles in Halifax, Warren, Nash, and Franklin counties. The rocks are dioritic eruptives and chloritic schists, striking N. 50° to 60° E., and dipping southeast.

The Carolina slate belt embraces an area from 8 to 50 miles in width, extending in a southwesterly direction across the central part of North Carolina into the northern part of South Carolina, where it appears to sink beneath the coastal plain, and reappears in the eastern part of Georgia. The rocks are metamorphosed sedimentary slates and schists, at times highly silicified, and devitrified ancient volcanic rocks, often sheared. The strike is N. 20° to 55° E., and the dip steeply towards the northwest. Dikes of diabase are of frequent occurrence.

The Carolina igneous belt adjoins the slate belt on the west, and has a width of from 15 to 30 miles. The auriferous portion embraces an area of about 1,000 square miles. The rocks are granitic, dioritic, gabbroitic, and diabasic eruptives.

The King's Mountain belt lies to the west of the igneous belt, extending across North Carolina. The productive points are widely scattered, and constitute a small aggregate area. The rocks are gneisses and schists, with some siliceous limestones, having northeast strike and southeast dip.

The South Mountain belt begins in the western part of North Carolina, in Caldwell, Burke, McDowell, and Rutherford counties on

SAMPLING ORE. LOCKHART MINE, ONE MILE EAST OF DAHLONEGA, GA.

the eastern flanks of the Blue Ridge, and extends into the northwestern part of South Carolina. The rocks are dioritic and granitic gneisses, striking northwest and southeast with gentle northeast dips over a large part of the area, and also northeast and southwest with southeast dips.

The Georgia belt begins in the northeastern corner of the State,

"LOWER CUT," CHESTATEE PLACER MINE. NEAR DAHLONEGA, GA.

and extends in a southwesterly direction to the Alabama line. Its maximum width is 30 miles. The rocks are very similar to those of the South Mountain belt.

The Alabama belt is a continuation of the Georgia belt in Alabama, and constitutes the southwestern extremity of the southern gold field. The rocks are argillaceous slates and mica-schists and gneisses.

Of all these belts, the Carolina slate, the Carolina igneous, and the Georgia are the best developed, and perhaps the most important.

The gold-ore deposits are of three main structural types:

(1) The placer deposits, which may again be subdivided into (*a*) stream gravel deposits in both present and ancient channels, (*b*) gulch deposits, concentrated by means of secular movements, independent of fluviatile action, and (*c*) the saprolite* deposits, or the decomposed country rock in place.

* The word "saprolite" is derived from the Greek, signifying rotten rock, and was first applied by Mr. Geo. F. Becker of the United States geological survey. The depth of the saprolites in the southern States varies from 25 to 100 feet.

HYDRAULIC MINING. BARLOW MINE, DAHLONEGA, GA.

(2) Quartz fissure veins, containing free gold and gold in combination with sulphurets, which may in turn be differentiated into (*a*) clean-cut fissures of some persistence, (*b*) a system of smaller and larger lenticular veins, approximately conformable to the schistosity of the rocks, but also intersecting the same, usually at small angles, and (*c*) a system of reticulated veins.

(3) Impregnations of free gold and finely-divided auriferous sulphurets in the country schists and slates, sometimes accompanied by small lenticular quartz intercalations. These auriferous schists are at times hundreds of feet in width, though not necessarily capable of being profitably worked over their whole extent; they constitute the low-grade ore bodies of the south.

The character of the ores is not unlike that of most other gold fields. The chief gangue mineral of the fissures is quartz, varying from saccharoidal to vitreous, and containing fragments and partings of the country rocks. Barite, calcite, and siderite are of occasional occurrence. At one locality (King's Mountain mine, N. C.) the veinstone is largely siliceous magnesian limestone.

WATER POWER PLANT OF THE CHESTATEE COMPANY, DAHLONEGA, GA.

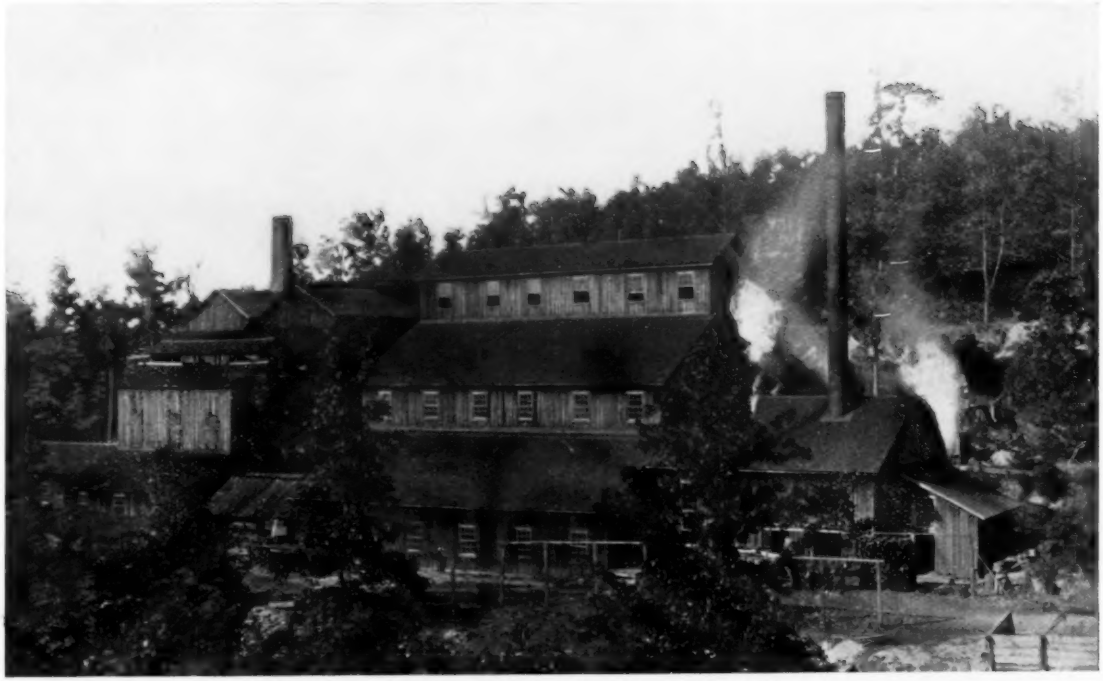
In the auriferous slate deposits irregular lenticular quartz stringers are almost always present, and the slates are generally silicified in varying degrees up to such hardness that they resist scratching with a knife.

WROUGHT IRON SIPHON (3 FT. INSIDE DIAM.), 2000 FT. LONG ON THE HAND-BARLOW DITCH LINE, CROSSING THE YAHOOLAH VALLEY ONE MILE FROM DAHLONEGA, GA.

BIG CUT. RUSSELL MINE, GLEN BROOK, N. C.

FORTY-STAMP MILL AND CYANIDE PLANT. RUSSELL MINE, MONTGOMERY CO., N. C.

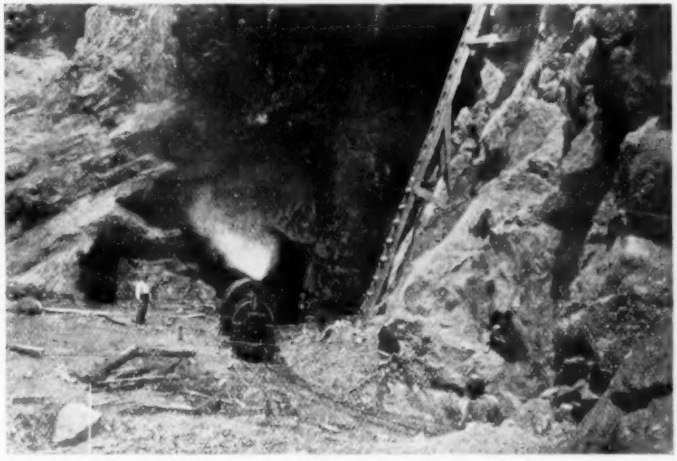
WATER POWER, STAMP MILL, AND CHLORINATION PLANT. FRANKLIN MINE, GA.



FORTY-STAMP MILL AND CHLORINATION WORKS. BREWER MINE, S. C.

Below the water level, which occurs usually twenty-five to fifty feet below the surface, sulphurets make their appearance. These are mainly pyrite, though chalcopyrite, galena, and zinc-blende are frequently present in certain localities, and mispickel is comparatively rare. In certain groups of mines, particularly in the Carolina igneous belt, chalcopyrite often predominates. In a few localities (Silver Hill, Silver Valley, and other mines, N. C.) galena and zinc-blende predominate, and are high in silver; but these complex sulphurets have never been worked to any important extent, owing to the metallurgical difficulties attending their treatment. Tellurids are of very rare occurrence in southern ores.

It is of course difficult to give any fair idea of the value of southern ores. In the placer gravels this is well-nigh impossible, as no systematic records are at hand, and it is doubtful if any were ever kept. Compared with other gravel deposits, as those of California or New Zealand, the area and extent of the southern deposits are very limited. The virgin ground undoubtedly yielded handsome returns, though it was imperfectly worked, for many of the old tailings dumps have been washed over a second, third, and even as often as a seventh time at a profit. Channels running as high as $20 per cubic yard are recorded,



NORTH TUNNEL. BREWER MINE, S. C.

but perhaps the vast majority of the ground worked yielded between 25 cents and $1.00 per cubic yard.

The auriferous saprolite bodies of the Dahlonega district in Georgia

BIRD'S-EYE VIEW OF DAHLONEGA FROM PREACHER GOLD MINE.

are exceedingly variable in value. Certain small quartz stringers may run up very high. Material as low as 40 cents per ton (equal to 12 cents per ton material mined) has been milled at a profit, but, as a rule, the grade of the mill-stuff is somewhat higher.

It is impossible to make any reliable statements regarding the quartz veins, the variation is so great. However, it may be said that generally the concentrated sulphurets run from $30 to $40 per ton,—*i. e.*, after the extraction of the free-milling portion, which may be from 20 to 50 per cent. of the value of the ore. The large bodies of low-grade auriferous schists may yield anywhere from $2.00 to $5.00 per ton in quantity.

Placer mining was the first mode of winning gold in the south, and many of the mechanisms now used universally, such as the rocker and long tom, originated here. At the present day very few gravel mines are in operation. Of those that are, two classes may be named: (1) operations on virgin deposits; (2) operations on ground that has already been worked.

Of the first a good example is the Crawford mine in Stanly county, N. C., four miles southeast from Albemarle. It was first opened in 1892. The gravel bed, composed of angular quartz and slate fragments in a clay matrix, occurs in a narrow stream bottom, perhaps 250 feet in width. Its thickness is 1½ to 2 feet, and the overlay is from 2 to 4 feet deep Owing to the scarcity of water here, a novel method of washing is pursued. A wooden tank, of 200 cubic yards capacity, is situated at some elevation above the stream bed. At one end is a standpipe 30 feet high, which is supplied with water from a reservoir below, by a steam pump. The gravel is hauled to the top of the tank in tram-cars and dumped. Here it is washed by the discharge from the standpipe. A line of riffled sluice-boxes runs from an opening in one side and near the bottom of the tank. The gold is collected from the bottom of the tank, and from the riffles in the sluices. It occurs almost exclusively in the shape of nuggets; no quicksilver is used. In April, 1895, an 8-pound nugget was found, and in August of the same year one weighing 10 pounds. The cost of working is estimated at about 50 cents per loose cubic yard.

Of the second class, the Mills property at Brindletown, Burke county, N. C., is perhaps the best example. During the past summer extensive preparations were in progress to work the old tailing heaps of Silver creek valley, by the use of hydraulic giants and gravel elevators. Other placer mines that attained some importance at one time or another in the south are the Sam Christian, Montgomery county, N. C.; the Parker mine, Stanly county, N. C.; Nacoochee Valley, Ga.; Arbacoochee, Ala.; etc.

The Chestatee company, near Dahlonega, Ga., is now at work hydraulicking a canal, half a mile in length, into which to turn the Chestatee river, from its present course, and expose its bed of auriferous gravel for mining operations.

A unique method of mining is practised in the Dahlonega district, Ga., consisting of a combination hydraulicking, sluicing, and milling process. The ore bodies are the large masses of auriferous schists, decomposed to great depths (25 to 150 feet), which are cut down by hydraulic giants, and the material led through ground and box-sluices to the stamp mills, situated at some distance. The cost of mining and milling by this method is from 18 to 25 cents per ton milled.

The facilities for water in the southern mining camps are, as a rule, fair, though, as everywhere, beset with local difficulties. At the Sam Christian and Parker mines, for instance, expensive pumping plants and pipe lines, several miles in length, were necessary in order to obtain the requisite amount and head. On the Mills property some twenty miles of ditch and flume lines furnish the water, with a head of 60 to 200 feet. In the Dahlonega district there are over eighty miles of ditching, and two large siphon lines.

Of the quartz veins and mining it may be said that the free-milling gossan or brown ores of the upper decomposed zone are practically worked out by this time, and mining is directed to the deeper, sulphuretted, and, as a rule, less rich ores. One of the best examples of an actively-producing mine of this class is the Franklin in Cherokee county, Ga., sixteen miles northeast of Canton. The present mine workings are in the 350- and 430-foot levels. Four ore shoots, from 40 to 120 feet in length, and from 2 to 14 feet in width, have been opened. The dip is 40° S. E., and the pitch 45° N. E. The ore is quartz, carrying from 5 to 9 per cent. of coarse crystalline pyrites. About fifty per cent. of the gold is free-milling, and is extracted by amalgamation in a 20-stamp mill, handling 35 tons per 24 hours. The concentrates produced from ten Embrey tables in 24 hours is 5½ tons. The tailings run about 85 cents. The concentrates are treated in a Thies chlorination plant, the tailings from which run about 60 cents, giving an extraction of over 95 per cent. The total cost of mining, milling, roasting, and chlorinating is $2.70 per ton of ore mined.

As the best example of a mine working on a large body of low-grade slate ore, the Haile in Lancaster county, S. C., three miles northeast of Kershaw, is cited. The auriferous bodies are lenticular in shape, about 200 feet in length and 100 feet in maximum width. The pitch is 50° to 60° N. E. and the dip 45° N. W. to vertical. The ore consists of silicified sericitic schists, impregnated with free gold and sul-

phurets (pyrite, from 2 to 25 per cent.). The average assay value is about $4.00 per ton. Diabase dikes intersect the ore bodies, and the richest ores are usually found in their vicinity. The greatest depth of the workings is 270 feet. The mill is a 60-stamp one, and treats 120 tons of ore per day; about 33 per cent. of the gold is free milling, and the percentage of extraction is from 75 to 80 per cent. The concentrates from twenty Embrey tables amount to about 8 tons per 24 hours, and assay from $25 to $35 per ton. They are treated in a three-barrel Thies chlorination plant, where the extraction averages 94 per cent. The cost of roasting per ton of roasted concentrates is $2.58. The cost of chlorinating per ton of roasted concentrates is $1.45. The cost of roasting and chlorinating per ton of raw concentrates is $3.02, and per ton of ore mined 19 cents.

It now remains to draw some general conclusions, and to present some idea of the possible future of gold mining in the south. The above examples, taken from the few successful mines in the field, must not be accepted as typical. They are cited because the mines are developed, and in order to show what can be done. Of the great number of mines that have at one time or another been in operation in the south but few are now working, and still fewer productively. The causes of mining failures are numerous. As in all other mining districts a certain number of failures must be attributed to the incapacity of the mine itself. At the same time good mines have been injured by speculative maneuvers and stock manipulations. The introduction of numerous patent processes and mechanical contrivances of unquestionable inferiority, often approaching the ridiculous, for crushing, amalgamation, and other metallurgical treatment, explains the failure of many a mine; yet often the blame was attached, not to the defects of the process (where it belonged), but to the ores tested. After the true free milling brown ores were practically worked out, many operations were continued on the deeper sulphuretted ores, employing simple amalgamation without attempting to recover the gold in the sulphurets, which escaped in the tailings in enormous quantities. Again, a very general mistake has been the erection of costly milling and other machinery, previous to the proper opening of the mines, and without having sufficient ore in sight to supply the works. One great drawback to investors is the fact that many of the mining properties, even though entirely undeveloped, are held by the owners at figures so unreasonable and prohibitory as to preclude any fair deal The sooner the folly of this is realized, the better. Capital is needed in the south to develop its mineral resources, and mine owners must remember that the cost of an undeveloped mine is only a part of the ultimate expense of putting it in working and producing order.

All of these mistakes are gradually being comprehended, and the advantages of chlorination, cyanid treatment, and smelting are becoming known. The stamp mill, very properly, is more tenaciously adhered to than ever for crushing purposes. The economic success of the chlorination process, for the treatment of concentrated sulphurets, with an extraction of 90 to 98 per cent., has already been practically demonstrated by the excellent work at the Haile, Franklin, and other mines. It is stated that recent experiments at the Russell mine in Montgomery county, N. C., have shown that treatment by the cyanid process will cost from 90 cents to $1.00 per ton, on a scale of 100 tons per day, with an extraction of 85 to 90 per cent. For such mines as the Silver Hill and the Silver Valley, the complex sulphurets (galena, zinc-blende, etc.) must be treated by smelting; and for this purpose copper ores are necessary. Suitable auriferous copper ores do exist in many of the mines, notably those of the Carolina igneous belt. The establishment of custom sampling works and metallurgical plants, of which not one exists in the south to-day, and the reopening of mines necessary to supply them, are not unfeasible undertakings, though they may be difficult, and will require capital. But the advantage to the south cannot be overestimated.

Regarding placer mining, more systematic work is necessary. One of the chief difficulties is the fact that the deposits are in many cases below drainage; to overcome this, the more general adoption of the hydraulic elevator is recommended.

The history of gold mining in the south would form a long chapter if it were attempted to give in detail the manifold conditions, the rise and fall of the numerous ventures, which have led to the present neglected state of the industry. Suffice it to say here, that, although no bonanzas can be expected, workable bodies of ore exist, which may form the basis of profitable mining operations, so long as these are confined to legitimate ends, governed by sound and capable business and technical management, and protected from the interference of patent charlatan processes. The treatment of low-grade sulphurets is the ultimate problem in almost every mining camp; and so in the south these must be the main source of its gold production. It is believed that the state of the industry is approaching a healthier condition, and that the preparations now in progress and the growing interest manifested in the development of the resources of the south point to a reasonable revival of gold mining, with an increased production, though it may be many years before it can attain even its former maximum production.

THE COMMERCIAL EXPLOITATION OF ELECTRICITY.

By Burton E. Greene.

THAT the electrical industry of the United States is not in a commercially healthy condition is known to every one engaged in it. That it has never returned to the investor any reasonable profit is equally well known, as is also the fact that the small army of patient and worthy inventors have received scant reward for their labors. The general public, or, at least, that portion depending upon the daily press for electrical information, does not perhaps realize this; but every man who has come into close touch with the industry acknowledges it with regret. It may be profitable, therefore, to review briefly the commercial development of the art, and to point out the reasons for the past and present unsatisfactory conditions.

To cure a disease, it is first necessary to know just what the disease is. And to purify the electrical trade, and effect a revolution and a reëstablishment upon sound and profit earning lines, it is necessary to consider the causes which have clogged its progress.

It is not within the scope of this article to take into account any applications of the art other than those of electric lighting and power, and these only in their commercial aspects. These branches of the industry may be said to be twenty years old, dating back to the organization of the Brush Electric Company about 1877. Little was done until after 1880, when capitalists generally began to take active interest, and when newspaper articles showing the marvellous possibilities became common. And it is not too much to say that even the "booming" articles in the daily press, prepared by paid agents of the manufacturing companies, were well within the bounds of truth as to the possibilities of development, except in the one important point of *the cost of producing power*. To the shame of some of our leading inventors, it must be admitted that these misrepresentations emanated chiefly from those who knew better, and the lay public was soon convinced that there were fabulous profits in the business. On this popular misconception promoters and speculators have worked ever since, to their own enrichment, but to the loss of millions of honestly-invested capital.

To the leaders in the science it was as well known in 1880 as today that electric lighting could never compete with gas on the score of economy. Yet the literature given out by one of the pioneer com-

panies in incandescent lighting boldly claimed that gas-lighting was doomed, and with the untruth carried conviction so far that a general panic in gas stocks resulted. Upon these flat misrepresentations and misconceptions electric stocks were "boomed" to fabulous prices, one stock in particular selling at over $5,000 per share on a par value of $100. The public seemed ready to buy anything in the form of electrical securities. They had been educated to believe that electricity was a synonym for the touch of Midas, and the education had been conducted by experts.

Probably the fundamental cause of the large losses of capital with which the record of the trade has been blackened was that the commercial men who took control of the larger companies, in ignorance of the facts, pushed the business too rapidly. If a few more years had been spent in *developing* apparatus before forcing it upon the public, the results would have been different. One of the earliest salesmen in the trade recently said to the writer: "Up to 1885 we all knew that, when we had sold a man a plant, he had wasted his money; we knew the apparatus was not commercial; but we were hired to sell goods, and we sold them."

The stories of fabulous profits and quick results attracted an army of adventurers and speculators. Scores of men who had never made headway in any other undertaking thought they had found in the electrical business the long-looked-for opportunity of making money without honest labor. For years this class was conspicuously in the foreground, while the honest and hardworking inventor found it more and more difficult to secure legitimate reward for his labor. Many of these promoters and speculators were of small mental calibre, totally unfitted for the conduct of large enterprises. Gradually they sank to their proper level, but meantime the money of the misguided investor was being spent in extravagances and bad management.

Notwithstanding the handicap of incompetent business management, the inefficiency of the early apparatus, and the discouragement of pioneer investors, the business grew. It could not be prevented from growing. It is a fair estimate that up to to-day $750,000,000 have been invested in electric railway and lighting plants. Returns to stockholders in dividends have been insignificant. Why should this be so? No one reason can be considered sufficient to answer the question.

One of the curses of the business, from its inception, has been the insatiate desire to control, to drive out all competitors, to monopolize. This spirit permeated every one of the larger corporations throughout the period when the product was being sold at prices giving a profit of from three hundred to five hundred per cent. over

shop cost. It was this spirit, conceived in arrogance, which, more than any thing else, shaped the policy of all, and caused the expenditure of millions upon millions in profitless patent litigation.

It has become quite the fashion in the trade to deride the American patent system, because so few electrical patents have been sustained. The fault, however, does not lie with the patent system. In fact, in many cases the invalidation of electrical patents has been, not a fault, but a credit to our American judiciary, who have grasped the truths which electrical men generally have ignored. Those in control have believed, or assumed to believe, that the art itself was born after 1880. They have ignored the facts of record,—that the fundamental principles had been for years taught in the leading schools, especially in Germany, England, and Scotland; that the commercial adaptation of well-understood foundation principles was scarcely in the nature of invention, but rather development,—the natural result of so many bright minds, fertile in expedients, laboring for a common end. Acting upon this misconception, each one of the large companies claimed for itself the sole right to do business, and a campaign of patent litigation and bluster never paralleled in the history of the world's business was begun. Up to a few years ago every man in this country, with any standing in and knowledge of the art, was under a regular retainer from one or another company. And, for all the vast sums expended, no one has reaped any considerable financial reward as the result of litigation.

More than this, the desire to control bred other evils, worse than wasteful litigation. It took such complete mastery of some of the leaders that the legitimate manufacturing and selling business was ignored, or left solely in the hands of minor employees, without experience and without judgment. Years were wasted in making trades, deals, and working arrangements, none of which have had any result other than preventing the achievement of substantial commercial success.

The third unfortunate feature which has marked the course of the electrical trade, more justly open to criticism than any other, more responsible for the distrust and suspicion with which electrical investments are now regarded, has been the manipulation of stocks by those in control of the prominent companies. This is a disease not easy to eradicate, but which must be eradicated before the trade will ever be upon a solid basis, and before the stockholder can be assured that the affairs of his company are being administered in his interest instead of for the personal enrichment of stock-jobbers and speculators. Up to 1890 speculation was in the air, tickers were placed in offices of the companies, and even humble employees were not discouraged from gambling in the securities of the company by which they were employed, or those of that company's rivals. Since 1893 speculation has been

discouraged among the rank and file, but has been cultivated more assiduously than ever among the officers of some of the parent companies. That no officer of any corporation should speculate in the securities of his corporation is a proposition beyond argument. That no executive officer of a manufacturing corporation should speculate at all is equally beyond argument.

To this prevalent fever of speculation and stock-jobbing, may be traced many of the evils which have blotted the pages of the commercial history of the art in this country. Shares could be "boomed" only on a showing of large profits. Large profits could not be shown without a large gross business. Therefore, every effort was put forth to make the latter look as large as possible. The business was not left to develop itself. It was forced. The laws of commerce were ignored. Electrical companies did not wait for local capitalists to become sufficiently interested to invest in lighting or railway plants. The scope of what should have been solely a manufacturing company was widened to include the business of promoting, building, exploiting, financing, and running electric-light stations and railroads. Stocks and bonds were taken in payment for apparatus sold, and, though worth perhaps only fifty cents on the dollar, went into the sales account at par, making a paper showing of immense business. Financing companies were organized for the sole business of marketing these securities. Millions of bonds taken by the manufacturing companies at sixty were finally sold to the public at ninety. The inevitable result of this plan was the establishment of a large number of unprofitable plants, the over-capitalizing of nearly every plant so sold, and the flooding of the money markets with millions of securities on which the earning of interest was an impossibility. Thus even the legitimate branches of the business have been put under a cloud, and all classes of electrical securities have been smirched with suspicion; and this in the face of the undoubted fact that the best investments in America are those in electric-lighting and electric-railway companies, when capitalized at anywhere near their actual value.

No stronger proof is necessary that the general conduct of the business has been utterly wrong than the fact that, of all the large pioneer companies doing business before 1886, not one remains. They have either failed and gone out of business, or lost their identity in unfortunate amalgamations.

Reference has been made to the large number of speculators and promoters attracted to the trade in the earlier years. Added to the injury to the trade inflicted by the misguided management of companies established upon a legitimate foundation, there was the grosser injury suffered from the parasites and marauders who had nothing of merit to

work on, and who organized companies solely for the sale of worthless stock, using the magic word electricity to float their schemes. As an object lesson, we lay before the readers of THE ENGINEERING MAGAZINE the records of *one State* alone. The accompanying table shows the electrical manufacturing and selling companies incorporated in New York State from October, 1875, to November 9, 1895. The list does not include either railway or lighting companies, but all corporations, legitimate and illegitimate, whose business was to be the sale of apparatus, supplies, or patent rights. In every case *some stock was sold.* A careful perusal will show that the frauds and humbugs have been largely in the majority. The record is appalling as it stands,—nearly $412,000,000 for New York State,—but does not include the bonded and floating debt—merely the authorized capital stock. In several other States the operations of the schemers are in evidence on a scale of corresponding magnitude. Illinois, Maine, Massachusetts, Ohio, Pennsylvania, New York, and Connecticut aggregate not far from $1,800,000,000 paper capitalization for the same class of companies.

No one with the best interests of the industry at heart can look upon this record of stock-jobbing with other than feelings of misgiving and sorrow. It would be worse than useless to discuss the subject now, were it not that plenty of evidence exists to prove that the lessons of the past have not yet had the proper influence upon the electrical public. All evils of this kind gradually cure themselves, and it is gratifying to observe that conditions are steadily improving. There are to-day scores of concerns conducting their affairs in accordance with sound and established commercial principles. This could not be said ten years ago.

What has occurred is now a matter of history. What has the future in store? Founded upon the science of electrics, there is what may become the grandest industry of this or any other century. The *scientific* triumphs are beyond dispute. Can the industry be made profitable? It surely can. No better proof of this is needed than that companies which lost money ten or even five years ago are now making money, with product selling at from one third to one-fourth of what it was sold for then. Reforms have been inaugurated. They should be prosecuted with earnestness; and the power to *force* these reforms rests with the common stockholders in electrical manufacturing companies. Let them see to it that the speculative element is displaced in the management, and that conservative and experienced manufacturers are placed in charge. Let the lesson be thoroughly inculcated that speculation and speculative methods have no place in any manufacturing business.

ELECTRICAL AND MANUFACTURING COMPANIES INCORPORATED IN NEW YORK STATE FROM OCTOBER 18, 1875, TO NOVEMBER 9, 1895.

Arnoux Hochhausen Electric Co.	$ 100,000
American Dynamo Electric Machine Co.	5,000
American Electric Co	125,000
Alexander, Barney & Chapin, N. Y.	100,000
Am. El. Ry. Co., N. Y	1,000,000
" " Mfg. Co., N. Y	3,000,000
" " Time Co., N. Y	100,000
" " Const. Co., N. Y. (Limited)	20,000
" " " " " "	100,000
Am. Underground Electric Wire Co	1,000,000
Am. Electric Arms & Ammunition Co	1,000,000
Am. Electric Lamp Co	150,000
Am. Electric Transportation Co., N. Y	1,000,000
" Natl Tel. Co., N. Y	5,000,000
" El. Supply Co., Buffalo	20,000
Alexander Chamberlain Electric Co	1,000
American Electrical Publishing Co	5,000
Atlantic Electrical Manufacturing Co	100,000
Automatic Electric Railway-Signal Co	3,000
Anglo-Am El. Ass'n, B'klyn	100,000
Atlas Tel. & Tel Co., N. Y	10,000,000
" El. Co., N. Y	400,000
Automatic El. Power Co., N. Y	500,000
" " Current Arrester Co., N. Y	100,000
" " Stock Machine Co., Castleton	200,000
" " Lt. Co., N., Y	200,000
Averell Insulating Conduit Co. of N. Y.	5,000,000
American Electric Light Co	500,000
Albany Electric Illuminating Co	100,000
American Electric Light Co	400,000
American Electric Railway & Power Co	10,000,000
Ball El. Illt. Co., N. Y	250,000
" " Lt. Co., N. Y	2,000,000
Balet El. Mfg Co., Bklyn	300,000
Bass " " "	50,000
Battery Lt. & Power Co., Buffalo	1,000,000
Bergman El. & Gas Fixture Co., N. Y	250,000
" Gas & Electric Fixture Co	100,000
Bishop G. P. Co., N. Y	40,000
Bock Elect. Co., N. Y	1,000,000
Bogota El. Lt. Co., N. Y	100,000
Brooklyn El. Tim. Co	50,000
" " Co	50,000
" " Lines Co	2,000,000
Buell El. & Pneumatic Co., N. Y	10,000
Ball Electric Mfg. Co., N. Y	500,000
Baxter Electric Lt. Co., N. Y	2,000,000
Bradley Electric Power Co., N. Y	1,000,000
Bonsilate Electric Mfg. Co., Albany	100,000
Brooklyn Electric Const. Co	100,000
Brush-Swan Electric Lt. Co. of New England, N. Y	2,000,000
Buffalo Electric Wks	50,000
Barriett Electric Motor & Dynamo Co	20,000
Burton Electric Co	10,000
Burlington Electric Land Association	60,000
Bentley-Knight El. Ry. Co., N. Y	1,000,000
Buell Electrical & Hydraulic Mfg. Co., N. Y.	500,000
Brush Electric Co	3,000,000
Brush Electric Illuminating Co	1,000,000
Brooklyn Electric Light Co	2,500,000
Blanchard Electric Light & Power Co	1,000,000
Cabot El. Lt. & Mfg. Co	100,000
Central Imperial El Lt. Co	2,000,000
Chapman El. Motor Co., N. Y	500,000
Columbia El. L. & Mfg Co., N. Y	1,500,000
Commercial U. S. Elect Supply Co	5,000
" El. Supply Co	150,000
Connecticut Electric Mfg. Co	200,000
Carroll Electric Co	100,000
Cataract General Electric Co	8,000
Chapin-Douglas Electric Co	10,000
Columbian Electric Co	5,000
Columbia Electric Co	5,000
Consumers' Electrical Supply	1,000
Conteo Electric Co	15,000
Columbia Telephone Mfg. Co	$ 100,000
C. & C. El. Co	200,000
Central Electrical Co., N. Y	25,000
" Gas & El. Fixture Co., N. Y	500,000
Cleveland Motor Co., N. Y	50,000
Columbia Tel. Mfg. Co., N. Y	3,000
Commercial El. Co., Bklyn (Limited)	5,000
Constant Current El. Storage Co., N. Y.	15,000
Continental El. Co.	500,000
Consolidated El. Lt. Co.	2,500,000
Crocker-Wheeler El. Motor Co	100,000
Crosby El Co., N. Y	100,000
Crescent Electric Light & Motor Power Co.	500,000
Central N. Y. Electric Light & Power Co	50,000
Daft El. Lt. Co	3,000,000
De Groot El. Co.	10,000
Drawbaugh Tel. Syndicate, N. Y	3,200,000
Dickinson Electric Supply Co	10,000
Direct Acting Electric Gong Co	15,000
Domestic Electric Mfg. Co	500,000
" Thermo Electric Lt. Co., N. Y	1,000,000
Dynamo Electric Power & Light Co.	5,000,000
Dynamo Electric Co	500,000
" Edison Co. for Isolated Lighting	1,000,000
Eastern Telegraph Co	10,000
Elbridge Electrical Mfg. Co	10,000
Electric Arc Light Co	100,000
" Boiler Co. of Rochester, N. Y	50,000
" City Land Co	9,000
" City Mfg. Co. (Limited)	30,000
Eagle El. Co., N. Y	2,000
Edison El. Fire Exterminator Co., N. Y	500,000
Edison, Gilliland & Co., N. Y	100,000
Ed. Genl. El. Co., N. Y	12,000,000
Eickemeyer Dynamo Mach. Co., Yonkers	60,000
Eickmeyer-Field Co., N. Y	1,000,000
Electric Steering Co., N. Y	600,000
" Disinfection Co., N. Y	200,000
" Locomotive & Ry. Supply Mfg. Co., N. Y	1,000,000
" Educator & Supply Co	250,000
" & Telephone U. G. Conduit Co	1,000,000
" Bulletin Co	25,000
" Locomotive & Ry. Supply Mfg. Co	1,000,000
" Appliance Co., N. Y	20,000
" Mfg. Co., Bklyn	100,000
" Lt. & Supply Co., N. Y	10,000
" Power Co., N. Y	700,000
" Fire Protective Co., N. Y	300,000
Edison Electric Light Co	720,000
" E. L. Co. of Europe (Limited)	2,000,000
Electric City Promoting Co	20,000
" Construction & Supply Co	12,000
" Engineering & Supply Co	50,000
" Experimental & Developing Co	43,000
" Inspection & Repair Co	15,000
" Co. of Olean, N. Y	40,000
" Metal Polish Co	1,000
" Power	20,000
" Toy Co	10,000
" Telegraph Co. of Westchester, N. Y.	10,000
Electrical & Mechanical Engineering & Trading Co	150,000
" Engraving Co	5,000
" & Mechanical Mfg. Co	15,000
" Age Publishing Co	5,000
Electrozone Co	500,000
Empire Electric Co	25,000
" State Telephone & Telegraph Co	250,000
" State Electric Forging Co	300,000
Electric Signal & Time Register Co., N. Y.	100,000
Electro Chemical Amalgamate Co	10,000,000
Electrical Storage & Power Co	100,000
" Const. Co	10,000
" Candle Co	200,000
" Accumulator Co	5,000,000

Electric Arms Co.	$1,000,000
Equitable El. Co., N. Y.	5,000
Electric Ry. Co of the U. S.	2,000,000
" Conduit Const. Co.	1,000,000
" Const. & Supply Co.	120,000
" Storage & Mfg. Co.	2,000,000
" Cutlery Co., N. Y.	25,000
" Wiring & Const. Co., Bklyn.	25,000
" Engineering & Supply Co., Syracuse.	25,000
" Pneumatic Time Co., N. Y.	100 000
" Co. of N. Y.	100,000
" Mfg. & Gas Engine Co., Seneca Falls.	100,000
Empire Electrical Mfg. Co., Bklyn.	100,000
" Safety Lt., Heat & Power Co.	5,000
" City El. Co.	100,000
Enholm Electrical Const. Co., N. Y.	100,000
Eureka El. Co., N. Y.	100,000
Excelsior El. Apparatus Co., N. Y.	10,000
" Genl. El. Co.	15,000,000
Electric Sugar Refining Co., N. Y.	1,000,000
" Ordnance Co., N. Y.	1,000,000
Electrical Distribution Supply Co., N. Y.	1,000,000
Electric Ry. Signal Co., N. Y.	3,000,000
Edison Electric Light Co. of Havana	1,000,000
" Electric Light Co. of Porto Rico	1,000,000
Electric Motive Power Co.	500,000
Excelsior Electric Co.	500,000
Fuller Electrical Co.	870,000
Franklin Electric Light Co.	600,000
Faure Electric Storage & Light Co.	2,000,000
Fitch Electric Lighting & Const. Co.	100 000
Fithian Engine & Electric Light Co.	1,250,000
Foster Electric Motor Co.	100,000
Franklin & Faraday Electric Co., Ltd.	100,000
Faraday El. Cable Co , N. Y.	100,000
Franklin El. Lt. & Power Co., N. Y.	1,500
" " Mfg. Co., N. Y.	25,000
Fuller-Wood El. Lt. Co., (Limited)	50,000
Globe El. Supply Const. Co.	25,000
General Electric Co.	50,000,000
Globe Electric Construction Co.	20 000
Hall Telephone Co., N. Y.	500,000
Herzog El. Appliance Co.	140,000
" Teleseme Co. of N. Y. State.	500,000
Hobby El. Lt. Co. of N. Y.	50,000
Highland Falls Water & El. Power Co	15,000
Haldreze El. Motor Co., N. Y.	20,000
Household El. Lt. Mfg. Co.	500,000
Hercules Electric Co.	5,000
Hecla El. Lt. Co., N. Y.	5,000
Haddan Electric Ry. Signal Co.	500,000
Hathaway El. Lt. & Power Co.	10,000,000
Hussey Elect. Lt. & Power Co.	1,000,000
Herzog Electric Co.	110.000
Higgs Electric Lt. & Power Co.	500,000
Howard El. Line Co., N. Y., Ltd.	100,000
Home El. & Mfg. Co., N. Y.	50,000
Hussey Electro Magnetic Motor Co.	300,000
Higgs Electric Light & Power Co.	500,000
Hussey Electro Magnetic Engine Co.	100,000
India Rubber & Gutta Percha Co., N. Y.	250,000
Industrial Lt. Co., N. Y.	300,000
Interior Electrical Conduit Co., N. Y.	150,000
Imperial Electric Lamp Co.	250,000
International Electric Forging Co.	6,000
" Telegraph & Telephone Co.	5,000
Imperial Elect. Co.	1,000,000
International Electric Exchange & Supply Co.	300,000
International Electrical Co.	24,000
Jablochkoff Electric Lighting Co.	2,250,000
Jagel El. & Pneumatic Subway Co., N. Y.	1,000,000
Johnstone U. El. Lt. & Power Co., N. Y.	100,000
Keith Electric Co.	800,000
Knudson Electric Co., N. Y., Ltd.	10,000
Lugo Dynamo Electric Co.	100,000
Levett-Muller Electric Light Co.	1,000,000
Lockwood-Foster Electric Co., N. Y.	100,000
Lumley Electric Light & Power Supply Co., N. Y.	$ 250,000
Maine Electric Lt. & Storage Co., N. Y.	2,000,000
Massachusetts El. Lt. Co., N. Y.	500,000
Metropolitan Electric Lt. & Power Co. of the U. S.	150,000
Metropolitan Electric Lt. & Power Co. of the State of N. Y.	300,000
Magic Telephone Co., N. Y.	5,000,000
Magneto Telegraph Co., N. Y.	5,000,000
Manhattan El. Cable Co., N. Y.	1,000,000
" " Co.	250,000
" " Supply Co., N. Y.	10,000
Maracaibo El. Lt. Co., N. Y., Ltd.	100,000
Marvin El. Drill Co., Syracuse	300,000
Mutual Electric Light & Supply Co.	500,000
Mutual El. Protective Assn'n, N. Y.	60,000
Manhattan Electric Power Co.	100,000
Metropolitan Electric Light Co.	200,000
Markland Electric Light & Power Co.	600,000
Mason-Wood Electrical Mfg. Co., N. Y.	100,000
Merchants' El. Lt. & Power Co., N. Y.	200,000
Metropolitan El. Storage Co., N. Y.	25,000
" " Service Co., Rye	100,000
" " Signal Co., N. Y.	1,500,000
Mexico El. Co.	20,000
Microphone Battery Co., N. Y.	5,000
" Carbon Battery Co., N. Y.	25,000
Moffatt El. Const. Co., N. Y.	100,000
Mott Electro Motor Co., N. Y.	1,000,000
Mutual El. Mfg. Co., N. Y.	100,000
" Accumulator Co., Bklyn.	50,000
Mc Leod El. Mfg. Co., N. Y.	3,000
Mason El. Co., N. Y.	25,000
Mercantile El. Co., N. Y.	5,000
Met. El. Equipment Co., N. Y.	20,000
Molyneux El. Mfg. Co., Buffalo	30,000
Moone Electrical Co., N. Y.	50,000
Multiphase Motor Co., N. Y.	200,000
Monarch Electric Co., N. Y.	200,000
Mutual Electric Lt. & Mfg. Co.	1,000,000
N. Y. Electrical Clock & Signal Co.	500,000
N. Y. Electro-Magnetic Brass Co.	10,000,000
Natl. U. G. Electric Co. of the City of N. Y.	2,500,000
New England Electric Storage Co., N. Y.	2,000,000
N. Y. Electrical Ozone Co.	1,000,000
N. Y. Electric Co.	10,000
Natl. Storage Cable Co., Troy	5,000
N. Y. El. Equipment Co.	200,000
" " Wks.	50,000
" " Engineering Co.	10,000
" " Motor & Ventilator Co.	30,000
Natl. Conduit Mfg. Co., Hastings	250,000
" El. Protector Co., N. Y.	500,000
" " Co., N. Y.	250,000
" " Service Co., N. Y.	1,000,000
" " Const. Co., N. Y., Ltd.	20,000
" Galvanic Battery Co.	1,000,000
" Safety Lt. Heat & Power Co., N. Y.	5,000
" Transportation Motor Co., N. Y.	5,000,000
" El. Machine Co., N. Y.	20,000
" " Mfg. & Const. Co., Troy, N. Y.	50,000
Neutral Storage Battery & Power Co., N. Y.	200,000
New Am. El. Arc Lt. Co., N. Y.	1,000,000
No. Am. Telephone Co., N. Y.	1,000,000
" " U. S. Telegraph & El. Co., N. Y.	2,500,000
" " " " " El. Co.	5,000,000
" " El. Seal Unhairing Co., N. Y.	10,000
New York Auto-Telegraph Co.	2,000,000
N. Y. El. Time Co.	300,000
National Electric Light Co.	1,000
New York Electric Light Co.	5,000,000
National Electric Light & Power Co.	300,000
N Y. Electric Light Association	300,000
New Electric Light Co.	100,000
N. Y. Isolated Accumulator Co.	250,000
" Safety Lt. Heat & Power Co., N. Y.	250,000
" Novelty Co.	200,000
" Mail Box Co.	50,000
" Const. Co.	50,000

N. Y Equipment Co	$ 10,000
" Eureka Telephone Co., N. Y., Ltd	150,000
" El. Mfg. Co	100,000
" " Exchange	1,000
Ohmart Homans El. Ltg. Co., N. Y.	750,000
O'Keenan El. Mfg. Co	100,000
Olmsted El. Lt. & Power Co	1,000,000
Pan-Electric Telegraph	5,000,000
People's District El. Lt. Co., Brooklyn, Ltd.	225,000
" " " " " Binghamton	50,000
Perkins Electric Lt. Co., N. Y.	600,000
Phœnix Electric Co. for Canada	350,000
" " " of N. Y.	350,000
Piedmont Electric Illtg. Co., N. Y.	70,000
Panama El. Lt. Co., N. Y	200,000
Pennock U. G. Conduit & Surface Telegraph Co., N. Y.	100,000
People's El. Time Co., N. Y.	100,000
Phœnix El. Lt. & Power Co., N.Y. & Bklyn.	500,000
Planet El. Conductor Co	50,000
Popular El. Bell & Alarm Co., N. Y.	25,000
Poff Compressed Air & El. Power Co., N. Y.	1,000,000
Porter El. Messenger Co., N. Y.	200,000
Primary El. Co., N. Y.	240,000
Pulsion Telephone Co. of N. Y.	1,000,000
Pexnaux El. Co., N. Y.	2,000
Proctor-Raymond El. Co., Rochester	30,000
Pulsion Telephone Co. of West N. Y., Buf.	50,000
Remington Electric Lt. Co., N. Y.	500,000
Richtor Electric Lt. Co., N. Y.	500,000
Rogers Tel. & Tel. Co	5,000,000
" Telephone Co	1,000,000
Railway Tel. & Tel. Co., N. Y.	1,000,000
" El. Time Co	500,000
" Audible El. Signal Co	10,000
Roberts Battery Lt. & Power Co., N. Y.	5,000
Roberts-Brevoort El. Co., N. Y., Ltd.	100,000
Rome El. Protective Co., N. Y	100,000
Rochester Electric Light Co	100,000
Saratoga Electric Illuminating Co	50,000
Standard Electric Light Co	1,000,000
Spanish Am. Lt. & Power Co., N. Y.	2,000,000
Safety El. Power Co., N. Y.	600,000
" " Lt. & Power Co., N. Y	250,000
Safety Ins. Wire & Cable Co., N. Y.	500,000
" El. Lt. & Power Co., N. Y.	3,000,000
Sawyer-Man El. Co	125,000
Seibold Electroid Mfg. Co., N. Y.	100,000
Sachs El. Co., N. Y.	20,000
Scott El. Lamp Co	25,000
Slocum El. Co., N. Y.	50,000
Smith-Vassar Telephone Co., N. Y.	1,000,000
Sheriden El. Lt. Co. of N. Y.	500,000
Sims El. Torpedo Co., N. Y.	1,000,000
Slattery Incan. Lamp Co	200,000
Smith & Rhodes El. Co., N. Y.	10,000
Solar Arc Lamp Co., N. Y.	25,000
Solar El. Co., N. Y.	100,000
Southwestern Tel. & Tel. Co	3,000,000
Spalding Telegraph Co	1,000
Special Fire Alarm El. Signal Co., N. Y.	50,000
Syracuse Storage Battery Co	300,000
Shaver-Anglo-Am. Telephone Co	60,000
Sims-Edison El. Torpedo Co., N. Y.	1,000,000
Southern Holmes El. Protective Co., N. Y.	500,000
" Telegraph & Cable Co., N. Y.	100,000
Spanish Am. Lt. & Power Co., Consolidated, N. Y.	4,000,000
Sprague El. Ry. & Motor Co., N. Y.	1,600,000
Standard Telegraph & Conduit Co., N. Y.	2,500,000
Sunderland Telegraph Co., N. Y.	30,000
Solenoid El. Co., N. Y.	500,000
Solar Lt. Co., N. Y.	1,000,000
So. States El. Storage Co., N. Y.	2,000,000
" El. Lt. Co., N. Y.	500,000
Standard El. Mfg. Co., N. Y.	60,000
Swan Incan. El. Lt. Co., N. Y.	$ 800,000
Standard El. Co., N. Y.	500,000
" " Subway Co., N. Y.	250,000
Taylor Telegraph Co., Buffalo	20,000
Telemene El. Mfg. Co., N. Y.	75,000
Telephone Const. Co	30,000
Tesla El. Co	300,000
Thermo El. Battery Co., N. Y.	30,000
Troy El. Dynamo Co	20,000
T. F. Lipple Co	100,000
Thompson-Brown El. Co., N. Y.	25,000
Tilman Portable El. Lt. & Reflector Co., N. Y.	100,000
U. S. Electric Lines Conduit Co., N. Y.	500,000
" " Co., N. Y.	25,000
" Electrical Co., N. Y.	500,000
U. S. Wire & Cable Co., Schenectady	1,000,000
Universal El. Tunnel Co., N. Y.	25,000
" " Pull Socket & Switch Co	20,000
U. S. El. Lighting Co	1,500,000
" Illuminating Co	1,000,000
United Globe Electric Light Co	6,000,000
The U. S. Electric Engine Co	1,000,000
Universal Electric Light Co	10,000,000
U. S. El. Ltg. Co	2,000,000
United Edison Mfg. Co	1 000,000
Universal Arc Lamp Co., N. Y.	100,000
Van Choate El. Lt. Co., N. Y.	5,000,000
Vibratory El. Motor Co., N. Y.	1,000,000
Vance El. Co	10,000
Van Dirweyde El. Co	20,000
Wallace El. Tel. Mfg. Co., N. Y.	1,000,000
Western States El. Storage, N. Y.	2 000,000
Walcott Electrical Co., N. Y.	500,000
Wurtz Fuel Gas & El. Lt. Co., N. Y.	1,000,000
Wilson Bates El. Co., N. Y.	1,500
Waddell-Entz El. Co	150,000
Walenn Electro-Depository Co., N. Y.	1 000,000
Wenstrom No. El. Co., N. Y.	125,000
West Side El. Mfg. Co., N. Y.	12,000
Western Telegraph Const. Co	10.000
" N. Y. Mutual Tel. & Tel. Co	1,000
Weston El. Light Company	200,000
Wheaton Sub. El. Conduit Co., N. Y.	1,500,000
N. Y. Appelgate El. Matting Co	1,000,000
Ampere El. Co	100,000
Fitch Electric Light Co	100,000
Excelsior El. Co	482,500
Central American El. Lt. Co	300,000
New England El. Storage Co	2,000,000
Star El. Lt. & Power Co. of the U. S.	300,000
Schuyler El. Lt. Co	1,000,000
Marine El. Lt. & Storage Co	2,000,000
Empire Stale El. Lt. & Storage Co	100,000
New York & Brooklyn El. Lt. Co	25,000
Schuyler Foreign El. Lt. Co	1,000,000
Edison Spanish Colonial Co	100,000
Light & Force Co	5,000,000
Brush-Swan El. Lt. Co	2,000,000
N. Y. & Chicago El. Underground Co	2,500,000
Parker El. Mfg. Co	40,000
Binghamton Magneto El. Lt. & Power Co.	50,000
Burrows-Hyde Underground El. Cable Co.	100,000
Domestic El. Lt. & Power Co	1,200,000
Electric Const. & Supply Co	120,000
N. Y. El. Conduit Developing Co	500,000
Michigan Iron Wks. Lt. & Power Co	100 000
Paulett El. Steering Co. of N. Y.	500,000
Reversible Hydrostatic Motor Co	600,000
Schuyler Foreign El. Lt. Co	1,000,000
Argentine Edison Lt. Co	500,000
Automatic Current & Protector & El. Mfg. Co	2,500,000
Buffalo El. Wks	50,000
Total	411,854 500

LIMITS AND POSSIBILITIES OF THE GAS ENGINE.

By George Richmond.

THE success of the gas engine, of which at least fifty thousand must be in use at the present day, has not been due to its superior efficiency as a means of transforming heat into work. Availability, and convenience in use, as compared with steam, have been the chief factors in determining its adoption. The recent construction of gas engines of large power—300, 400, or even 600 horse power—and the reports of performances which the steam engine cannot hope to equal, and the possibility of still greater efficiency, have combined to force attention to the claims of the gas engine as a rival of the steam engine in its own domain. A fairly-constructed gas engine of moderate, or even small, dimensions will convert into work eighteen to twenty per cent. of the heat supplied to it. This is not only very much better than the performance of any steam engine of comparable size, but superior to that of the more elaborate tripie-expansion engine.

The following table gives some of the best results on record for the steam engine.*

The most sanguine engineer hardly expects to obtain any serious

Type of engine.	Absolute boiler pressure lbs per sq in.	Steam used per hour per I H. P. lbs	Percentage of W realized.	Thermodynamic efficiency.
Single-cyl. beam pumping engine (Mair-Rumbley)	59	21.3	46	0.11
Single-cyl. Corliss engine (Hill)	111	19.4	44	0.12
Single-cyl. Sulzer engine (Linde)	105	19.0	45	0.12
Two-cyl. compound beam pumping engine (Mair-Rumbley)	76	14.8	63	c.15
Two-cyl. compound Worthington "High Duty" pumping engine (Unwin)	75 90	17.7 17.4	53 51	0.13 0.13
Two-cyl. compound pumping engine (Leavitt). (Mean of two trials)	114	14.05	60	0.16
Two-cyl. compound high speed single-acting engine (Willans)	180 (about)	14 26	54	0.16
Triple marine engine of S. S. "Iona" (Kennedy)	180	13.35	58	0.17
Triple experimental engine (Reynolds)	207	12.68	59	0.18
Triple high speed single-acting engine (Willans)	190 (about)	12.74	60	0.18
Triple Sulzer engine (Schroter)	171	12.2	64	0.19

* "The Steam Engine and Other Heat Engines," Ewing.

improvement on the best results now recorded for the steam engine. A little less than eleven pounds of steam and a little more than one pound of coal to the horse power is apparently the ultimate limit of steam-engine economy. On the other hand, gas engines using "producer" gas regularly yield one horse power to about seven-eighths of a pound of coal. In both cases the figures are in terms of indicated horse power, but the mechanical efficiency of the gas engine is about the same as that of the compound or triple-expansion engine.

There are probably few industries in which the cost of power bears so large a ratio to the total expense that one-eighth of a pound of coal per horse power would in itself have much weight in determining the choice. Nevertheless, the gas engine, having established its claim to consideration, could, and undoubtedly will, be adopted in many cases with great advantage, in preference to steam power. For it must be remembered that the present claim of the gas engine is not simply that it is well adapted to special applications; all this has been conceded,—with a certain patronizing condescension, it is true. The advocate of the gas engine no longer pleads extenuating circumstances, but boldly claims recognition on an equal footing with steam. This confidence is based partly on accomplished facts, but largely on expectations of greatly-increased efficiency. As to the maximum efficiency to be obtained in practice the doctors differ; a conservative writer puts it at forty per cent.; a more hopeful one proposes a plan by which upward of seventy per cent. of the heat supplied is expected to be turned into work. This would mean less than half a pound of coal in the one case, and about a quarter of a pound in the other, for one horse power per hour; should either of these efficiencies be realized, the fate of the steam engine would be sealed.

The operation of a gas engine of the ordinary four-stroke type is too well understood to need description, but it may be pointed out that its action and theory do not differ essentially from those of the steam engine. We may consider that air, instead of water, is pumped into the boiler, and that each cylinder charge is heated on its way (after being shut off from the boiler) to the temperature it acquires by combustion in the cylinder. We perceive at once an obvious advantage in performing the combustion actually within the cylinder, since the loss of heat in the chimney is eliminated.

It is usual to refer all heat engines to the perfect heat engine imagined by Carnot, in which the efficiency depends only on the initial and final temperatures being very simply expressed by the fraction:

$$\frac{\text{Temperature of Supply—Temperature of Rejection}}{\text{Temperature of Supply.}}$$

This in many cases is extremely misleading, and justifies suppositions very far from the truth. As a matter of fact, it is very easy to determine, for any given heat engine employing in a given cycle an agent whose physical properties are known, the precise amount of heat that can possibly be converted into work under the given conditions. The ratio of this to the total heat supplied is the highest efficiency obtainable, and the only one with which we have any practical concern, except when the relative advantage of different agents is in question.

This question, which is usually ignored in the loose application of the Carnot ratio $\frac{T^1 - T^2}{T_1}$ to the ordinary gas engine, is precisely the most important in the present connection. A gas engine working on the "Otto" cycle could not possibly utilize as much heat (barely half as much) as a steam engine working between the same temperatures, and the current statements that the gas engine utilizes a much smaller proportion of the available heat than the steam engine are greatly exaggerated. Failure to recognize this fact not only raises expectations which can never be realized, but diverts the mind from the fact that an approach to the ideal efficiency can be realized only by a radical departure from the "Otto" cycle; if this is not practicable, then we must be content with a moderate improvement in the efficiency of the gas engine. For example, the statement that the gas engine is capable of converting into work seventy or eighty per cent. of the heat supplied to it is not true as applied to the gas engine, as we are acquainted with it. The "Otto" cycle is now so universally adopted that no other is ever suggested by the term gas engine. Now, as this engine is usually run, the heat available for transformation into work does not amount to more than thirty-four or thirty-six per cent. of the heat supplied. Therefore *an ordinary gas engine will compare favorably with the best compound or triple-expansion engine in both thermal and mechanical efficiency.*

In the above table the third column gives the percentage of available heat actually converted into work. The available heat in this case is not that of an ideal cycle between highest and lowest temperatures, but that of the actual steam engine cycle. Now, a gas engine converting twenty out of thirty-four per cent. of available heat realizes about sixty per cent., which is higher than the average realization of the steam engines in the table. The corollary to this is that the present gas engine is susceptible of only very slight improvement in efficiency Theoretically the efficiency could be increased almost indefinitely by increasing the compression, and one plan contemplates at least ninety atmospheres. On this point an expert entitled to the most respectful attention writes as follows: *

* "The Gas Engine," Dugald Clerk. J. Wiley & Sons.

"Can this principle be much further extended in its application? In the author's opinion, no. By undue increase of compression the negative work of the engine would be much increased, and the strains would become so great that heavier and more bulky engines would be required for any given power. Friction due to this increases more rapidly than efficiency; consequently the gain in indicated efficiency would be more than compensated by loss of effective power.

One means of improving the cycle itself has received a great deal of attention from inventors; in fact, nearly every maker of gas engines has tried to utilize it. The circumstance that in the gas engine the burnt gases are allowed to escape at a pressure much above that of the atmosphere never fails to impress the casual observer. To him compression seems an evil,—necessary perhaps,—but complete expansion appeals so strongly to his imagination that he is astonished that no one, prior to himself, has thought of such an obvious opportunity of improving the efficiency. Many ingenious schemes for realizing this modification of the "Otto" cycle have failed; their failure hitherto has been chiefly due to the fact that it involves a great increase in the volume of the cylinder for a given power. A consideration of the fact that, for a given volume of piston displacement, the *amount* of heat involved is very different in the two cases will indicate the reason why methods suitable for the steam engine are entirely inapplicable to the gas engine.

At a pressure of 45 lbs. one cubic foot of steam contains 130 thermal units, while a cubic foot of air at 45 lbs. pressure and 740 deg. (the absolute temperature of the exhaust usual in practice) contains only 13 thermal units. From this it is obvious that the losses incidental to compounding, which would be insignificant in the case of steam, would be absolutely fatal in the case of the gas engine. The most promising attempt to utilize more complete expansion was that of the Atkinson engine; but notwithstanding the fact that compounding took place within one single cylinder and with great rapidity, the gain was insignificant, and, taking into account the increase of available energy, the thermal efficiency of the engine was reduced.

If we are thus cut off from improvement whether by increasing the compression or by increasing the expansion, the conclusion is inevitable that the gas engine is as near to its final efficiency as the steam engine. There would seem, however, to be more chance of success in the line of increased compression, the difficulties in this case being chiefly mechanical, and not, as in the other case, physical. An extreme application of this principle was planned by Herr Diesel.*

* "Theory and Construction of a Rational Heat Motor," R. Diesel. Translated by Bryan Donkin. Spon.

The extreme diversity of views and emphatic statement of them current might be moderated by a clearer apprehension of the principles involved, it is equally pertinent to remark that the flippant charge of incompetency made against gas engineers is entirely unwarranted. A steam engineer can design a steam engine on any given lines, and predict very closely the result; a corresponding prediction for a gas engine departing from known and tried conditions is a sign, not of knowledge of the subject, but of ignorance of its complexity. The final result to be achieved may be perfectly definite, but experience shows that it can be approached only by tentative balancing of conflicting conditions. The theory of the gas engine, as of any other heat engine, is really very simple, and, in view of the necessity of keeping them in mind in this connection, an attempt has been made in the appendix to this paper to present the leading facts as free from technicalities as possible. It may be perfectly true, as asserted, that the art is very much further advanced in Europe than in America. Nevertheless, the importance of the gas engine of large power, as a possible rival to the steam engine, is receiving recognition. It is said that the Westinghouse Company is preparing a gas engine which is to be an advance upon those at present in use. The information has come to the public in the interview form, with characteristic vagueness as to detail; confidence, however, is inspired by the fact that the performance (three-quarters of a pound of coal to the horse power) claimed is well within possible limits. The De La Vergne Refrigerating Machine Company, which has created a special department for the manufacture of oil engines, has for several years been collecting data and studying the subject of gas engines of large power, and is understood to be prepared to put them on the market, should their investigation lead to any substantial improvement on existing types. Others are doubtless working at the same problem, and it is satisfactory to know that the interests of the gas engine are in the hands of firms capable of intelligent, and, above all, sustained, effort; nor is there any reason to fear that America will be left behind in this industry.

Oil engines (which constitute another special form of the hot-air engine) are apparently destined to supplant of both gas engines and steam for moderate power. They have all the advantages of the gas engine, with the additional advantages of costing considerably less to run and being available in situations where gas cannot be obtained. The gasoline engine has enjoyed an ephemeral popularity, and will probably still continue in use where neither gas or oil has been made available. This is notably the case in the so-called "horseless carriage," or automobile,—the application at present most in evidence.

The difficulties in this case are complex, and about equally divided between the motor and the transmission mechanism. The partial mechanical success obtained in Europe has created a craze for this class of vehicle. At present the inventors are exhausting all the possible ways of "how not to do it." Nevertheless, to the careful observer some of the most pronounced failures are more suggestive than the most correct designs. The name "horseless carriage" while it correctly represents the sphere of present activity also indicates wherein the same is at fault. No really successful self-propelling vehicle will be produced until not only the horse but the carriage builder is eliminated. The Pullman car is not a horseless stage coach, and the motor vehicle of the future will not be a horseless carriage.

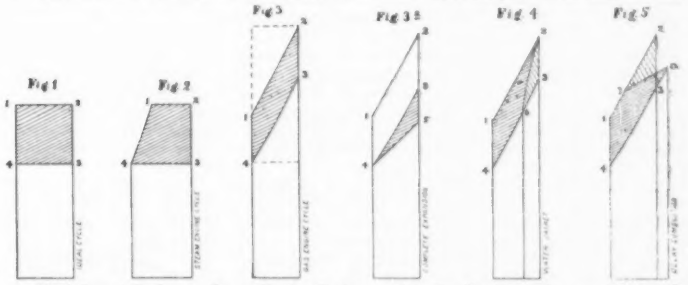
As regards the motor, no new principle is likely to be evolved, while we may expect many novelties in the way of mechanical construction. When the machine proper is lightened to the greatest possible extent, there still remains the necessity of carrying water for the cylinder. One horse power means the turning of heat into work at the rate of about forty-three thermal units per minute. The heat passing into the jacket is about two and one-half times this, or, say, one hundred thermal units per minute. If a three or four horse power motor is used, there is more heat than can be gotten rid of by conduction in any air-cooling device of reasonable dimensions, and a considerable weight of water must be carried, boiled away, and renewed.

One inventor boldly "denies the allegation and defies the alligator," and also explains. The first explanation was that the motor, by virtue of using liquid gasoline, was a refrigerating machine in combination with an engine. As the latent heat of gasoline is about one per cent. of the heat of combustion, this explanation is clearly inadequate. The second explanation is a double spark, the first cooling and "ripening" the mixture, while the second ignites it.

The interest in this explanation is confined to the treatment of it in the technical press, as indicating the extent to which the principles of thermodynamics are or are not accepted, as the case may be. If one is willing to sacrifice the efficiency, it is easy to see how, in accordance with well-known principles, a large portion of the jacket heat may be thrown into the exhaust. The mean temperature of the cylinder must be maintained within moderate limits. Now, the initial temperature may be reduced by working with a very weak mixture, which results in delayed combustion, and the final temperature may be reduced by increasing expansion, the simplest and crudest method of obtaining which is to choke the suction. For further reduction of the mean cylinder temperature add misfires in sufficient quantity.

APPENDIX.

If the quantity of heat supplied to an engine be represented by a rectangle whose height is equal to the absolute temperature (on any convenient scale) at which the heat is supplied, then this may be divided into two parts by a horizontal line drawn at the temperature at which the heat is rejected(Fig. 1). The ratio of the part cut off from the line



1—Ideal Carnot Cycle. 2—Steam Engine Cycle. 3—Otto Gas Eugine Cycle. 3a—Ditto with Complete Expansion. 4—Ditto with Water Jacket. 5—Effect of Delayed Combustion (Nachbrennen).

to the whole line is evidently $\frac{T^1-T^2}{T^2}$, and the rectangles on these lines represent respectively the heat transformed into work and the total heat. Moreover, following the shaded rectangle around is equivalent to reading off the physical changes of the agent. Taking steam, for example, and commencing at the corner marked 1. From 1 to 2, heat is added without increase of temperature (water evaporated at temperature T^1). From 2 to 3, the temperature is reduced without addition or removal of heat (adiabatic expansion). From 3 to 4, heat is removed without change of temperature (condensation). From 4 to 1, temperature is realized without addition or removal of heat (adiabatic compression). This is the ideal cycle, and that of the ordinary steam engine differs from it mainly in the fact that hot water at temperature T^1 is not produced by compression of partially-condensed steam, but by application of heat at constant pressure in the boiler. The rise in temperature, then, from 4 to 1 is accompanied by a progressive addition of heat, and the line bends to the right, as in Figure 2. The ratio of the shaded portion to the whole area is less than in the previous case, and this new ratio is the highest efficiency obtainable with the ordinary steam engine. A consideration of these figures will explode a popular fallacy, which dies hard,—namely, that latent heat is a great drawback to the use of steam as an agent. It is obvious that, the greater the latent heat of the agent, the nearer the practical cycle of Fig. 2 approaches the ideal cycle of Fig. 1.

In the case of the gas engine on the "Otto" cycle the highest temperature is reached partly by compression and partly by the addition of heat by combustion at constant volume. In Fig. 3 compression raises the temperature from 4 to 1; and 1 to 2 marks the rise in temperature in consequence of the addition of heat, the amount of which is represented by the area swept out by the vertical line in travelling from 1 to 2. Since the specific heat of air at constant volume is only .169, this line, 1-2, is very much steeper than in the case of heating of water. From 2 to 3, the temperature of the air is reduced without addition or removal of heat (adiabatic expansion). The expansion is continued until the initial volume is reached, or the point 3 lies upon a line of equal volume drawn through 4. The shaded area, as in the previous case, represents the total amount of heat which it is possible to convert into work in the "Otto" cycle. If we draw a horizontal line through the points 2 to 4, we obtain the rectangle representing the available heat for an ideal engine working between the same temperature 2 and 4. The difference between these areas indicates very clearly the absurdity of applying the Carnot ratio to the "Otto" gas engine. All the facts and possibilities of this cycle can be read at a glance from this figure. It is obvious that the efficiency is proportional, not to difference between the highest and lowest temperatures, 2 and 4, but to the difference between the temperatures produced by compression and the initial temperature 4. From this it follows that the efficiency of the theoretical "Otto" cycle can be increased to any desired degree by increasing the compression. It does not, of course, follow that this would be true in actual practice.

The gain by complete expansion is seen in Fig. 3. The expansion, instead of stopping at the point 3, is continued till the atmospheric pressure is reached (Fig. 3*a*). At the point 4 the gas is at atmospheric pressure, and a line of equal pressure drawn through this point will be less steep than the line 4-3, since the specific heat of air at constant pressure is greater than at constant volume. This line will cut the vertical, 2-3, at the point 5, and the additional work obtained by complete expansion is that represented by the triangle, 4-3-5. Not only is the available heat of the gas engine much less than that of the ideal engine of similar range, but it is further diminished by two circumstances,—the one physical and easily understood, the other chemical and somewhat obscure. The temperature obtaining in the gas engine would make the cylinder nearly or quite red-hot, and render proper lubrication impossible. Hence the necessity of the water jacket, which carries away nearly one-half of the total heat supplied to the engine. This involves a great sacrifice of the available energy, but if the water jacket were suppressed the greater part of the heat it eliminates would go into the exhaust.

The action of the water jacket may be seen in Figure 4. During expansion heat is removed to an amount represented by the area swept out by the vertical in travelling to the left from 2 to 6. The area of available energy is diminished by the triangle, 2-3-6, and the exhaust heat is diminished by the area swept out by travelling from 3 to 6. This latter quantity of heat belongs to the exhaust or rejected heat, and it is immaterial whether it passes out in the jacket or the exhaust.

The sum of these two does not represent the fifty per cent. of jacket heat, for a large part of this is taken up during the exhaust stroke. The point 6 can be determined when the final temperature or pressure of expansion is known, and the two areas in question would be ascertained with sufficient accuracy by drawing a straight line from 2 to 6. On the indicator diagram this represents an expansion line considerably below the adiabatic curve. But the second circumstance has an opposite effect, and the combination of the two generally results in throwing the actual expansion line above the adiabatic. The reference here is to retarded combustion, or the celebrated "Nach-Brennung." It is found that at the moment of ignition the theoretical temperature 2 of Fig. 3 is not obtained, and consequently only the heat due to partial combustion is applied along the line, 4-2, the remainder being added during the expansion. Fig. 5 represents this phenomenon; the first ignition supplies heat from 1 to 7, and the expansion line is carried out of the vertical, over to 8, by the subsequent addition of heat. If the area by the path 1-7-8 (Fig. 5) is the same as that from 1 to 2 (Fig. 3), the combustion is completed at the end of the stroke. If it is less, then unconsumed gas is passed out with the exhaust. The positions of both the points 7 and 8 depend on a variety of circumstances, the most important being the proportion of gas to air at the time of ignition. Each of the circumstances indicated by Figs. 4 and 5, taken alone, represents a thermodynamic loss, but their combination and superposition would not therefore necessarily result in a practical loss,—might even result in gain.

The "Sterling" hot-air engine follows very closely the "Carnot" cycle, and there is no great difficulty in making the ordinary gas engine follow the same cycle. We have seen that the quality of steam which causes its practical cycle to approximate closely to the ideal cycle is its large latent heat. But latent heat, so called, is nothing more than heat transformed into work, largely molecular in the case of steam. In the gas engine, if the work is done at the rate of generation of the equivalent heat by combustion, we have an exactly corresponding condition. Moreover, we have become acquainted with concurrent combustion and transformation into work in the phenomenon of "Nach-Brennung." The line 7-8 in Fig 5 may become horizontal, and may easily be conceived to start at 1. It is merely a question of controlling the combustion and dilution.

Returning to our original Fig. 1 of the ideal cycle, suppose air (largely in excess of that required for complete combustion) and gas to be separately compressed to the temperature 1, assumed to be at least high enough for spontaneous combustion. If the air alone were let into the cylinder, it would be cooled by doing work against the piston. If sufficient gas to combine with the air were introduced, the temperature would instantly rise. But, if the gas is introduced in such quantities that the heat of combustion just balances the cooling of the expanding mixture, a constant temperature will be maintained, the heat supplied being equivalent to the work done. At 2 the supply of gas and air is cut off, and the temperature is reduced to 3 by adiabatic expansion. If at this stage it is compressed at constant temperature to 4, we have the complete Carnot cycle. This is substantially the cycle proposed by Herr Diesel.

RAILROAD ACCIDENT AND EMERGENCY SERVICE.

By W. L. Derr.

THE importance of opening a blockaded railroad line can best be appreciated by reflecting for a moment on the vast interests depending on the prompt movement of trains. Let us consider, for example, on any one of the lines running to New York city, transporting thousands of persons and hundreds of cars of freight daily, the great inconvenience to travelers, not to mention the losses to the railroad by delay and consequent damage to freight, caused by a few hours' blockade. Business matters disarranged by failure to reach one's destination at an appointed time or by inability to make deliveries of important freight; social affairs upset because of failure to arrive in time to participate in an important function.

Another consideration, and one whose consequences may be more far-reaching, is the blockade of a railroad engaged in handling troops and supplies in war operations. A few hours' delay in the delivery of troops or ammunition on a field of battle might be attended with the most disastrous results. There is no doubt that railroads will play an important part in the wars of the future, and a capable staff will find it necessary to watch the railroad wrecking force and equipment with the greatest care and to see that both the men and the tools are so placed as to be available at the shortest possible notice. In military operations a railroad wrecking outfit will be found almost indispensable in clearing the line for an advance movement or in blockading or destroying the line in a retreat.

First in importance in a wreck-train organization is the wrecking crew, the size of which depends largely on the work it has to perform. At a large wreck a force of from twenty to thirty men may sometimes be employed to advantage. It will usually be found, however, that a force of about sixteen men is sufficient to handle an ordinary wreck, if steam power is used in lifting. As in other lines of work, good discipline, which implies order and prompt obedience, is absolutely essential to success, and this can be commanded only through intelligent and properly-instructed workmen. The railroad wrecking force, often called upon individually to act and think promptly and correctly under extraordinary conditions, must be composed of men who are intelligent, well-informed in their business, and physically and mentally able to endure hardships which would, to say the least,

deter the average man. Wrecking is not a business for nervous or rattle-headed men, and no man who has a fear for his personal safety, or is inclined to "lie down" at a critical moment, should be attached to a force having that work to do.

A knowledge of rigging and of other work connected with cordage is as essential to the wrecker as it is to the sailor. The wrecker must know how to splice a line, reeve a tackle, and tie the more common knots, such as the flat knot, bowline, two half-hitches and round turn, and timber hitch. He must know how to so care for ropes that they will at all times be in condition for use.

The wrecking foreman is usually a man who not only is familiar with his own class of work, but also has a general knowledge of the running of trains and the repair of track; who is ever ready to take advantage of the multiplicity of circumstances that may arise at any time, and capable of acting promptly, with clear head and firm hand, in difficult and dangerous situations. Men from the car-repair shops make the best wreckers. They work, in the course of their routine shop duties, with the very tools used at wrecks, and are therefore familiar with cranes, lifting jacks, tackle, levers, etc.

Some lines depend upon their trackmen to do the wrecking, but, owing to the difficulty of assembling them promptly,—the force usually being scattered over a considerable territory,—and to their lack of training in matters pertaining to such work, the practice cannot be commended. The same trackmen are seldom available the second time, so that there is not the chance of giving that class of workmen the training which this work calls for.

An important member of the wrecking crew is the cook. Wreckers seldom have time, after being ordered to a wreck, to get a supply of food at home to take with them; hence it is necessary to at all times have provisions on hand in the living car, and some one in the crew able to prepare it. The excellent canned goods which can be obtained everywhere insure a variety of good, wholesome food, than which there is nothing more essential to the wrecker, exposed as he is to all kinds of weather, being often called on to ply his vocation in the most severe storms,—and in other respects working under the most unfavorable conditions. To sum up, the wrecker should be an all-around good man, capable of doing a variety of work, the manner of doing which must necessarily, in many instances, be left to his own ingenuity.

In addition to its regular wrecking work, the wrecking force may, to good advantage, be drilled in fire service work, including bucket and ladder practice; and in this connection it is suggested that steam crane cars be provided with a fire pump, hose, and other appliances

for extinguishing fires at wrecks or elsewhere. The steam crane is usually kept with a banked fire under its boiler, so that steam can be raised at a moment's notice, and there are always plenty of men around the shops who are able to handle a fire pump and other fire appliances, even when the regular wrecking force is not at hand. Thus is provided a good and well-equipped fire apparatus, available at nearly all times. The wrecking outfit is generally stationed at points where there are important and valuable shops, offices, stations, and other property peculiarly liable to destruction by fire. In many instances these buildings are inaccessible to the engines of the local fire departments, while most of them are reached by the railroad tracks, making them entirely accessible to the steam crane car. Further, this apparatus may be sent, in case of fire, to outlying points, for the protection of railroad property.

The first aim of the wreckers, on arriving at the scene of a wreck, is, after caring for injured persons, to open the line for traffic as quickly as possible. This has to be done at the further sacrifice, in many instances, of rolling stock and the coarser kinds of freight, especially in a district where there is a heavy passenger traffic. On double-track lines the track more easily cleared is the first opened, for, with one track cleared, traffic can be resumed by operating a single-track line past the obstruction. In an open country, on single-track lines, it is often found advantageous to build a temporary track around the wreck.

In picking up damaged freight the most perishable and expensive kinds receive earliest attention. Fresh meat, fruit, and other stuffs of a highly perishable nature are cared for first. As soon as possible, damaged cars containing meat and fruit are boarded up to exclude air from their interiors. Perishable freight is usually—meat always—carried in refrigerator cars, and it is of the utmost importance that the outside air be kept from contact with it. Prompt action in this respect is absolutely necessary to prevent great damage. When meat has to be transferred to other cars, refrigerator cars, cleaned and well iced, should, if possible, be provided for the transfer. Refrigerator cars are equipped with hooks overhead for holding meat. Meat should not, be placed on the car floors, except in case of necessity. When meat has to be transferred into other than refrigerator cars, the cars should first be well cleaned and swept, and scrubbed with clean water, and all holes in their bodies cleated to exclude air. The floors should then be covered with a layer of clean ice, in as large cakes as possible. If the meat cannot be hung up in the cars,—and usually it cannot,—clean planking should be laid on the ice to support it. The meat should not be placed directly on the ice. The men engaged in trans-

ferring meat should keep their hands clean, and cover their clothes with clean burlaps. Rubber gloves will be found useful in handling meat, and will contribute to cleanliness.

The care of injured persons is, of course, the first and most important consideration at a wreck. Naturally the first duty is to make the injured as comfortable as possible, not forgetting to have the nearest surgeon called. The following excellent suggestions for the care, by employees, of the injured, until the arrival of a surgeon, are recommended by an association of railway surgeons, and, being divested of technicalities, can easily be comprehended by the layman :

When a person is injured and bleeding freely, elevate the limb or part, if possible, and draw the edges of the wound together with the fingers. Apply a closely-folded handkerchief or cloth (the cleaner the better) directly to the wound, and make pressure with it, or, if the hemorrhage is violent, apply a snugly-drawn bandage or handkerchief to the compress over the wound. A tight bandage must not be kept on too long ; the blood vessels and nerves may be injured by continued hard pressure. Cloths rung out of hot water and applied to a bleeding surface are an excellent means of checking hemorrhage. Slight oozing of dark-colored blood requires no compression. Never apply tobacco quids or other filthy substances to a wound. They do no good whatever, and only delay the healing process by poisoning the wound.

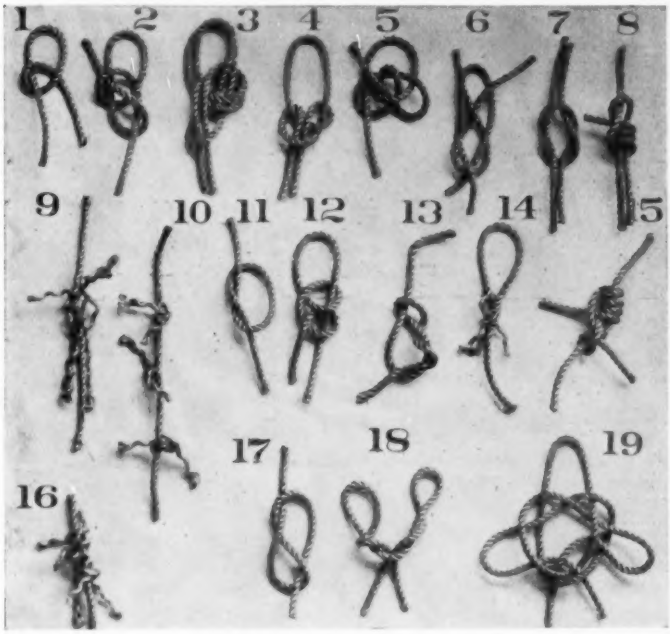
When a person is suffering from shock after an accident, keep the head low,—on a level with the body,—so that the circulation of blood may easily continue to the brain. While moderate stimulation may be useful in cases of shock, excessive use of alcoholic liquors is injurious. If whiskey is used, do not give over two or three tablespoonfuls. Hot coffee is a valuable remedy at such a time,—more valuable than whiskey. Apply warmth to the body, and rub the hands and feet to keep the blood circulating.

In carrying or transferring injured persons, handle them carefully, keeping the injured parts in the most natural and comfortable positions that circumstances will permit. Always support a crushed or fractured limb.

The writer has found the common passenger-coaches better adapted to the transportation of seriously-injured persons than Pullman cars, whose winding entrances are not convenient for the passing through of the stretchers. Furthermore, the seats of the common coaches are easier to arrange for the reception of persons on stretchers, and allow of better positions for rendering immediate surgical aid.

It is proper that wreckers and trainmen should be more or less familiar with such details, especially on lines running through thinly-

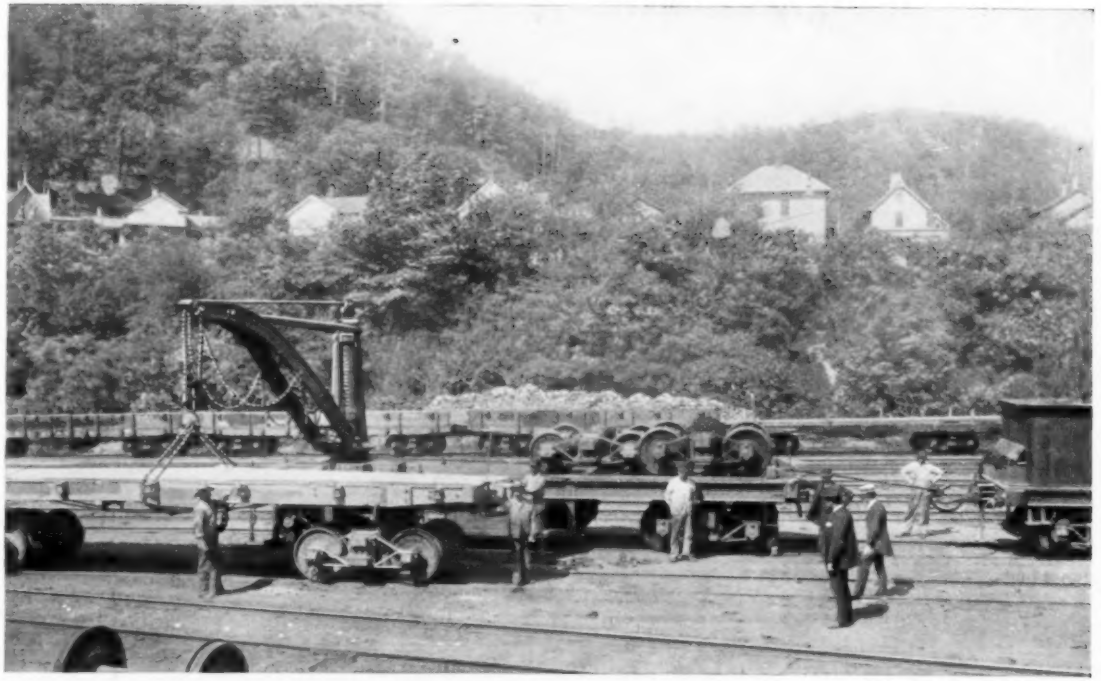
settled districts, where considerable time is likely to elapse before surgical attention can be secured. Suffering can be relieved greatly by even a slight knowledge of surgical practice, and by gentleness on the part of those handling injured persons.



SOME KNOTS USED IN WRECKING.

1—Commencement of a bowline. 2—Single bowline. 3—Double bowline on a bight. 4—Single bowline on a bight. 5—Running bowline. 6—Double Garrick bend. 7—Flat knot. 8—Fisherman's bend. 9—Short splice. 10—Long splice. 11—Overhand knot. 12—Two half-hitches. 13—Timber hitch. 14—Eye spliced in end of line. 15—Stopper on line. 16—Shroud knot used for putting two lines together when end is short. 17—Figure 8. 18—Cats-paw. 19—Mast-head knot.

Most railroads maintain a surgical staff, whose members are scattered along the line at convenient points. The staff is usually composed of local physicians, who attend to the railroad cases in addition to their other practice. On some roads, especially in the west, there is a chief surgeon, who has general supervision of surgical matters. Hospital facilities are also often provided by railroads at division terminals, the roads owning the hospitals outright or being shareholders, or having contracts with the owners.

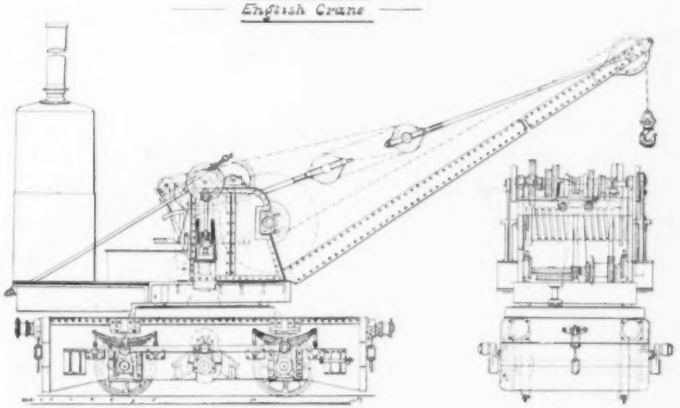


WRECKING DERRICK WITH LOCOMOTIVE HOIST.

A wrecking train usually consists of the locomotive, one and perhaps two crane cars, a tool and living car, sometimes an additional tool car for carrying blocking and the coarser tools, and a caboose.

Of wrecking equipment, first in importance are the crane and its car. There are three kinds of cranes used in this service,—hand-power, locomotive-power, and steam-power by hoisting engine attached to the crane. On account of the great weight of locomotives and of cars, the steam crane is the most desirable. A crane, to be of service in all cases, should have a lifting capacity of at least twenty-five tons. The car itself, including the tracks, should be of iron or steel throughout. It should be very strongly built, and have both hand- and air-brake appliances. Besides the ordinary air-brake equipment,

A Typical 10 Ton English Crane

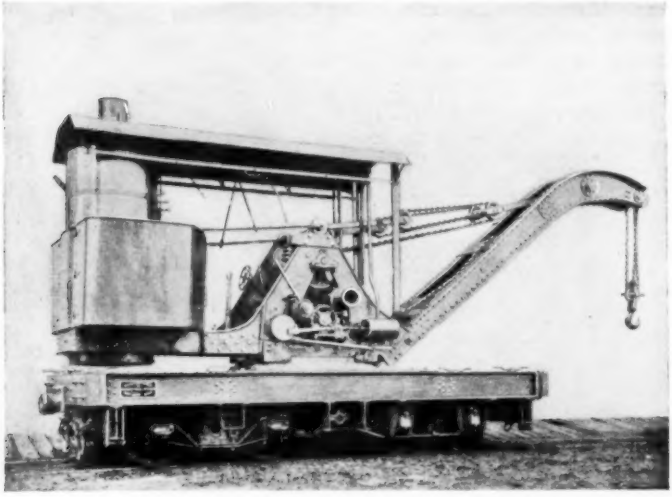


A TYPICAL 10-TON ENGLISH CRANE.

there should be an air pump operated by steam from the crane boiler, and an air reservoir to enable the air brakes to be operated on the wrecking train in the event of its being necessary to run the train with a locomotive not equipped with air brakes. The air may also be used to operate clutches, clamps, etc., on the crane. Modern crane cars are generally made self-propelling at low speeds. For anchoring the car when heavy side lifts are made, "outrigger" beams, their outer ends to rest on jacks, are provided, and so arranged that, when not in use, they can be stored under the car.

The crane should be of iron or steel, and the boom preferably of the plate girder type of construction, although rolled beams may be used with safety. The steam crane should be able to lift or lower

its load without reversing its engines, and to revolve in either direction. After lifting a load to a certain height, it is generally necessary to swing it to one side; hence the necessity of revolving the crane while it is in the act of lifting. A set of levers is provided for mani-



STEAM DERRICK.

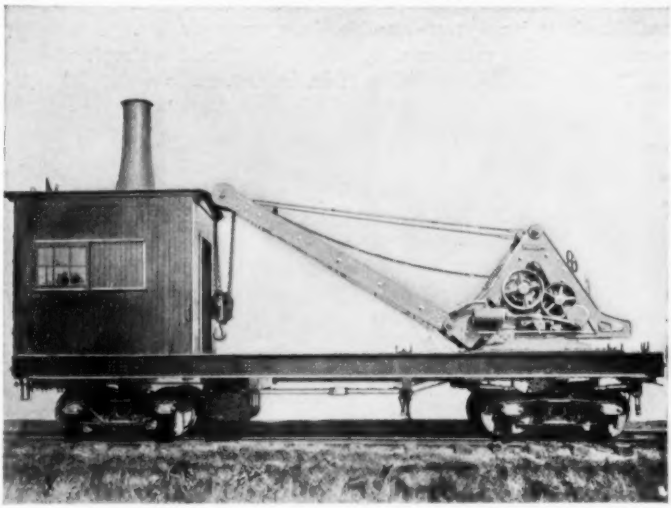
pulating the different movements of the crane. The levers are grouped so that the attendant can handle them all without changing his position. A further improvement in this line would be gained by arranging a lever for revolving the machine from the ground, when necessary, that being the best position for determining where the load should be swung. Following are the specifications of a well-known firm of builders, for the crane, engine, boiler, etc., of a 25-ton machine:

The frames of the crane are of cast iron, and to them are secured the boxes for the shafts operating the mechanism for hoisting, traveling, and slewing. The bearings are of ample size, made of bronze for important journals in frame, and babbit for others, and the shafts are of forged iron and steel. The operation of hoisting is through a train of spur-gearing operating directly the hoisting drum. There are also provided suitable lowering and sustaining brakes. Slewing the crane in either direction is accomplished without reversing the engine, by a double clutch, and by a train of spur- and worm-gearing, the worm-gearing locking the crane in any position. The gearing is of cast steel or bronze throughout. The levers controlling the different motions

are of forged iron, and so arranged as to work fore and aft. The jib is so curved that the extremity is horizontal when in position to operate at a radius of sixteen feet, and of sufficient strength to carry full load.

The engines are double, with cylinders nine inches in diameter by twelve inches stroke. There is a locomotive link reversing motion for traveling and operating the machinery in either direction. The cylinders are jacketed with asbestos, wood, and planished iron.

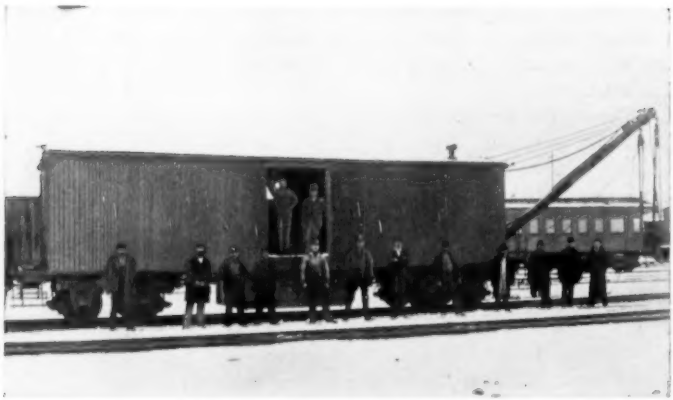
The boiler is of suitable size for the full capacity of the engines, is constructed entirely of flange steel, and has one hundred and thirty-four tubes two inches in diameter. Each tube is connected to its crown sheet by copper ferules, insuring durability and freedom from leakage. There are shaking grates, and lever for operating the same, the grate bars being about five-eighths of an inch apart. A jacket of asbestos, wood, and planished iron covers the boiler. The smoke stack is about four feet long. There are also a locomotive pop safety-valve, try cocks, gage cocks, water gage, blow-off cocks, etc.



TEN-TON AMERICAN CRANE.

For feeding the boiler there is a lifting injector of suitable size. The water tank, of plate steel, will hold two hundred gallons. A coal bunker is provided.

The tool and living car is an important as well as interesting feature of the wrecking equipment. It is usually divided into a tool



COMBINED DERRICK AND TOOL CAR.

and a living room and a kitchen. The tool room contains the hand tools, such as jacks ropes, tackle, bars, wrenches, etc. The living room is provided with seats, which can be utilized as sleeping-berths when required, a folding dining-table, lockers, and a desk. The kitchen is equipped with a range, coal bin, lockers, and a water-tank.

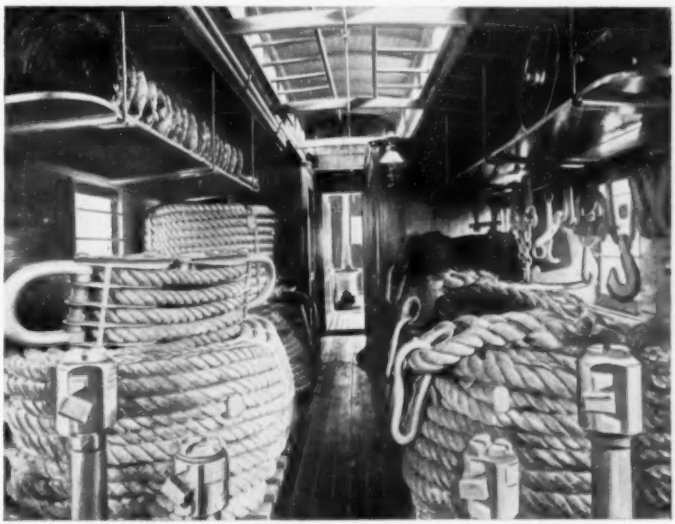
For raising weights a short distance, and for separating the wreckage so that the crane can get hold of the pieces, lifting jacks are used. These may be either hydraulic or screw jacks. The former are operated by hydraulic power, generated by small hand-pumps placed within the jacks themselves. For the hydraulic jack quick work under heavy

USING A DERRICK CAR FOR PUTTING TRUCKS UNDER A FREIGHT CAR.

load is claimed. The screw jack is operated on the well-known principle of the screw and lever. Its claim is simplicity of construction and ease of maintenance. Good work may be done with either type, and each has its strong points.

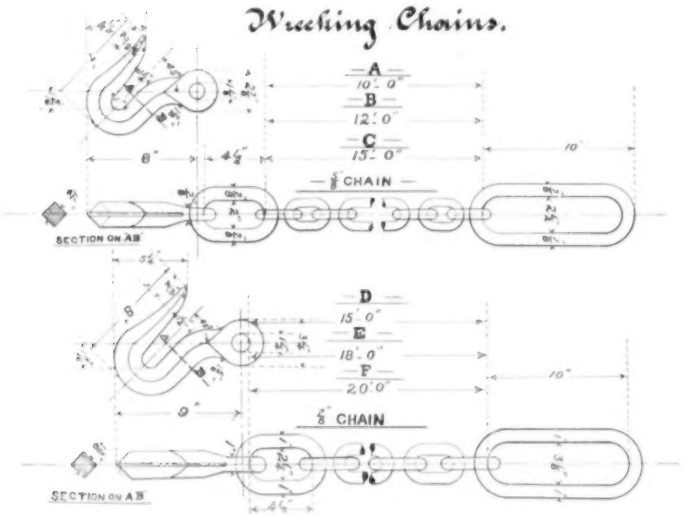
Wrecking frogs and wedges for rerailing cars are of various kinds, but all depend on the principle of the inclined plane. They are so designed as to cause the wheel, in the moving of the car, to rise, and at the same time to crowd toward the rail, and to slide onto it as soon as the proper level is reached. Wrecking frogs, as well as other wrecking tools, should be as light as the work will allow, as they frequently have to be carried by hand from place to place around a wreck.

Rope is distinguished as to size by its circumference in inches and fractions of an inch. No. 1 manila rope is the best fibrous rope for wrecking purposes. Fibrous rope should never be stowed away



TOOL-ROOM OF A WRECKING CAR.

until it is thoroughly dry, and should be kept in a dry place. Dampness weakens it, and makes it stiff and hard to handle, and is apt to swell it to such an extent that it is unavailable for use in the blocks for which it was intended, and through which it would run freely when dry. A four-strand rope is the best for working in tackle blocks. Being rounder than the three-strand, it produces less friction. When not in use, rope should be secure from contact with acid of any

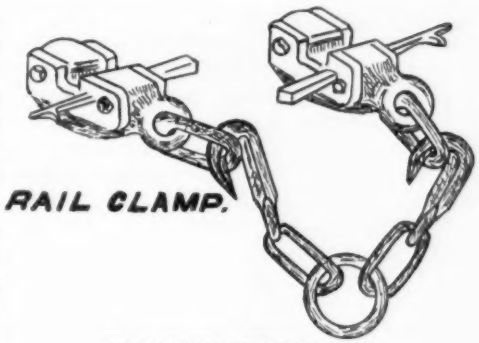


WRECKING CHAINS.

kind, or lime, soda ash, ashes, fertilizer, or even sand. After having been in contact with anything of this nature, it should be thoroughly cleaned. Tarred rope is seldom used in this service, because in cold weather it stiffens so much as to be almost unworkable. If, however, a rope is to be used in water only, as a drag rope or otherwise, it is well to have it tarred lightly, or, perhaps better still, well oiled. Wire rope is in many respects superior to fibrous rope for wrecking purposes. It is much lighter for the same service, will last longer, and is not affected by dampness. It is about four times as strong as manila rope.

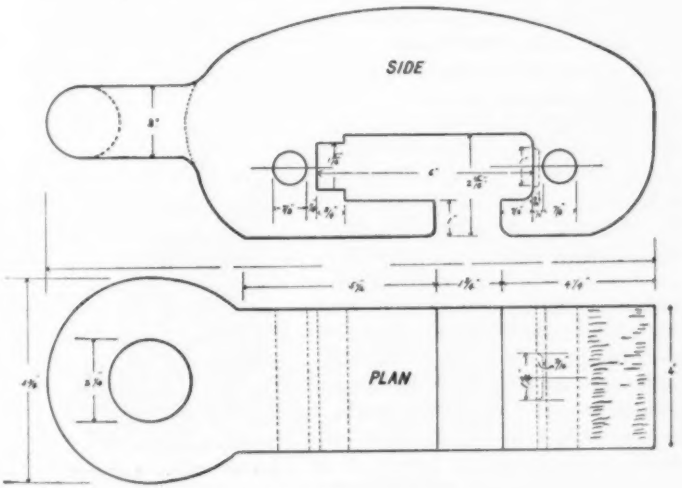
WRECKING FROGS.

A tackle block consists of a frame containing one or more groove-edged pulleys technically known as sheaves, which turn loosely on a common shaft. Formerly these frames were made of wood, but, owing to the very hard usage they receive in wrecking, they are now made of iron or steel. The theoretical advantage gained by tackle blocks where one rope runs through the whole is indicated by the power multiplied by the number of folds in the rope. This advantage is, however, considerably diminished in practice by stiffness of the rope and friction in the pulley bearings.



FOR FASTENING TACKLE TO TRACK.

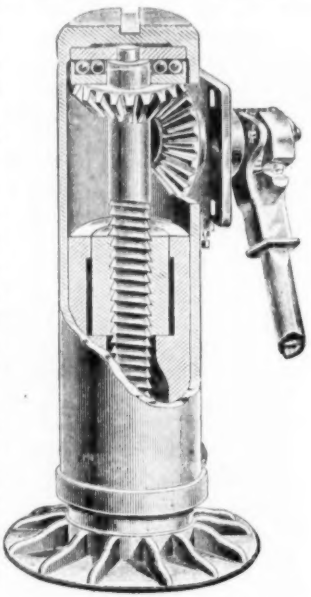
Mr. Joseph Glynn, in his excellent work on crane construction, recommends that hoisting chain be made with short links of oval form, the links to be no longer than is necessary to permit the use of tools for soundly welding the iron. His own practice induces him to recom-



RAIL CLAMP DRAWN TO SCALE.

mend that chains above an inch in diameter should not be used for crane work, preference being given to the smaller sizes, say, $\frac{5}{8}''$, $\frac{3}{4}''$, or $\frac{7}{8}''$ iron, the strain upon the chain to be reduced by increasing the number of the parts that bear it, by means of blocks and pulleys. The writer does not recommend links more than $\frac{3}{4}''$ in diameter for hoisting chain, on account of the excessive length of link in larger diameters, requiring a greater diameter of hoisting drum to avoid bending the links as they are wound under load around the drum.

The hoisting drum for chain should be spirally grooved to receive the edge of each alternate link. This prevents the chain from twisting as it winds, and gives each link a firm bearing, thereby reducing strain. The links of chain slings, or of chain for direct pulls and like uses, may be of any desirable diameter, since they are not subjected, like those of chain passing through tackle blocks, to the additional strain due to short bends. The hooks used with tackle blocks and chain should be carefully proportioned to the duty they have to perform. An egg-shaped section, the larger diameter on top where the rope or chain bears, gives the best results generally. The opening of the jaws of the hook should be sufficient to prevent the jamming of the rope or chain in the hook. A hook for hitching to the link of a chain is made of diamond-shaped section, with jaws open just enough to admit a link edgeways. A double hook of this kind may be used in making a quick splice of a broken chain, or for joining chains. When subjected to heavy transverse strains, hooks are apt to bend, and for this reason a shackle, which is simply a hook so arranged that both ends carry the load, is more suitable for lifting very heavy weights, such as locomotives.

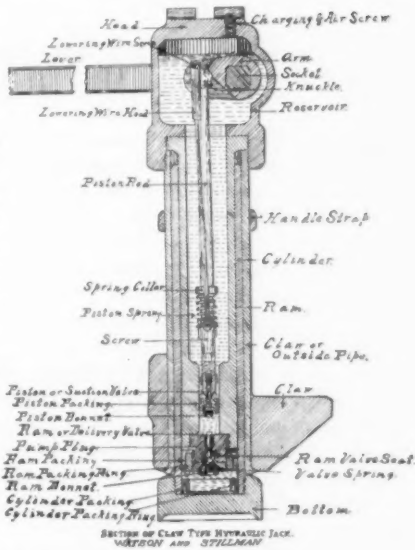


BALL-BEARING SCREW JACK.
NORTON TYPE.

For illuminating purposes at wrecks, different kinds of lights are used, but, so far, the main dependence has been placed on torches of large size mounted on posts driven into the ground at convenient points, and of smaller size for carrying in the hand.

The actual work of clearing away

a wreck is practically indescribable, even in a general way, as no two wrecks are alike. The aim is to save from further damage everything of value possible, consistent with the quickest reopening of the line for traffic. An oil wreck is the most dangerous and trying to handle, on account of its liability to fire. Fire usually results in explosions of the burning oil-tanks, making a very dangerous situation. Burning oil should be confined in as small a compass as possible, and then, if in large quantities, allowed to burn out, as there is but little chance of putting the fire out. In some cases, where the fire is a small one, the oil can be worked into positions favorable for smothering the fire with earth, the oil being run to such points through trenches dug for the purpose. The application of water serves only to make matters worse, by spreading the oil over a larger surface, permitting it to burn more freely. The use of a jet of steam for putting out oil fires has been suggested, but this method is seldom available at a railroad wreck. Where there are burning oil cars, the first thing to do is to get everything movable away from the fire as soon as possible, in order to prevent the fire from spreading. On some roads a small cannon is used for firing a shot into a burning oil tank, to let the oil escape before gas is generated and causes an explosion.



HYDRAULIC CLAW JACK.

With the great improvements brought about within the past decade in the construction and maintenance of track, bridges, engines, and cars, and in train-operating methods,—notably in the latter by the introduction of the absolute block system, which keeps trains a certain distance apart,—the chances for accident have been reduced to a point far below that gained in any other mode of travel. If statistics prove anything, it is that railroads offer by far the safest method of travel yet devised.

LOCATING A PUBLIC WATER-SUPPLY.

By Daniel W. Mead.

THE source of a public water-supply is one of the principal controlling factors in the design of a public water-works system. On the elevation at which water can be obtained depends the possibility of a gravity system or the necessity of pumping works. And, if the latter are necessary, the elevation further determines the class of pumping engines which must be used. On the quality of the supply depends the necessity of filtration, clarification, softening, etc., and on its freedom from present or possible future pollution depend the freedom of the community from the possibility of epidemics and the degree of vigilance with which the supply must be guarded. On its quantity depend the necessity of storage reservoirs and the expensive line of public works which this necessity involves. In fact, it may be stated that the selection of a source of supply is the paramount question in the design of a water-works system, and on it, perhaps more than on any one feature of the works, depends its financial and practical success.

Of the larger cities of the United States it is safe to say that the supply of at least fifty per cent. of them is entirely unsatisfactory, and the supply of a large proportion of the remaining number is far from what it should be. No question is, in fact, giving more trouble in its solution at the present time than the question of the source of the water-supplies of the cities of the United States. This, to a considerable extent, is unavoidable. A city has a limited choice of possible sources, and from such sources the problem often is to select the least objectionable. Again, supplies which may have been satisfactory at the inception of the works have been radically changed in character by the settlement of the country. The trouble is also due, in many instances, to a failure, in the original designing of the system, to properly consider the hydrological resources of the localities. Superficial examinations alone are made. The resources of a locality are examined as though they were isolated phenomena, whereas they are a part of a general system which, if studied and considered as a whole, would throw more light on the question and lead to a broader understanding of local resources and often to a more intelligent selection and design of the special system considered. The lakes, streams, and watersheds are self-evident, as are the ground waters which supply the common wells of each community, and these alone are commonly investigated. The deeper sources, when such exist, are often unconsid-

ered or overlooked, though they sometimes offer the cheapest means of securing pure and wholesome supplies. Intelligent design demands that due consideration be given to each possible source, and that the items of purity, quantity, cost, future extension, and protection from present or future contamination shall have each its due weight in determining choice.

To thoroughly comprehend the problem involved in the selection of a public water-supply, it is necessary to consider in detail the hydrology and hydro-geology of the entire region. The following discussion of the water supplies of southern Wisconsin and northern Illinois will serve to illustrate the extent and character of the necessary lines of study and inquiry.

The rainfall, to which ultimate source all available supplies may be traced, is exceedingly variable in quantity, and its careful study must precede the considerations of most questions of water-supply, and is especially important when limited watersheds are considered for surface supplies.

The ultimate disposal of the rainfall is modified by climate, temperature, vegetation, and geological conditions, which differ, not only with the locality, but with the season, and previous relative humidity. The rainfall is partially re-evaporated. A portion is absorbed by vegetation and utilized in plant growth and transpiration from plant surfaces. A large additional percentage flows away in the streams, while the balance sinks into the soil, furnishing the dry-weather flow of streams, the reservoir from which plant life draws its necessary supply during the rainless periods, and the waters which saturate the underlying geological strata.

The yearly distribution of the rainfall largely influences its ultimate distribution. When it is evenly distributed during the year, a larger proportion is absorbed by vegetation, imbibed by soil and rocks, and evaporated, and a smaller flows away in streams. Where the rainfall is concentrated in short periods, a larger percentage flows away in streams as flood waters, and a smaller is appropriated in other ways. The variation in the amount which may be assimilated by vegetation or evaporated during a short period is limited. So to a less degree is the imbibition of soils and rocks. For these strata, if once saturated, force the water to flow away as flood waters. A fall of an inch per hour may produce a considerable flood, especially with no vegetation and with frozen ground. The same fall distributed over twenty-four hours, with vegetation at its best and low ground water, may be scarcely noticeable in the flow of streams.

The relative amount of the total rainfall which may find its way into any one of the channels mentioned depends most largely, how-

ever, on geological conditions. The rate of inclination and nature of the surface, influencing the rapidity of the passage of waters over the surface, have a most important influence on the amount of water which flows away in streams or is lost through one of the other channels. With slight slope and high porosity the waters may cease entirely to appear in watercourses, but all be either evaporated, assimilated, or sunk into the porous strata. The geology of southern Wisconsin and northern Illinois, as it relates to the distribution of the waters of this region, may be briefly described as follows: This entire region is underlain by the Archæan rocks of unknown thickness, which, as far as our knowledge goes, may be regarded as the foundation rocks on which the overlying deposits rest. Among the Archæan rocks of Wisconsin are found the earliest of the known rocks, and from these have been formed, directly or indirectly, all later formations.

Since the beginning of geological history, the same agencies that are now at work pulling down the land surface and filling up the sea have been at work, aided or hindered by the great variations in climate. The rains soften and wear the rocks' surface, and cause the decomposition and disintegration of the most lasting rocks. The sea tumbles the rocks into the surf, and grinds them into sand and pebbles. The accumulated work of these agencies through ages has sufficed to pull down continents and build up deposits, which have formed new extents of the land surface, and which in their turn have been disintegrated and destroyed to form new and later deposits.

In this way the Archæan deposits were worn and disintegrated and formed the extensive beds of Potsdam sandstone which underlie almost the entire area under consideration, except that small portion where the Archæan rocks themselves still show their outcrop above the surrounding deposits. The Potsdam deposit consists essentially of sandstones derived from the broken quartz grains of the decomposed granites and allied rocks. Variations more or less extensive in the position of land surface and the condition of deposition gave rise to the series of deposits which lie above the Potsdam, and which are all of more or less importance in the question of water-supply.

It is, however, unnecessary for our purpose to enter on a detailed history of the geological developments of this territory. It is sufficient to know that the land gradually rose from the sea, until, at the end of the Carboniferous period, it was all above the sea-level.

The topography of this region at the beginning of the Quaternary age differed greatly from the present rolling prairie land which makes up most of this area. In its stead, rugged hills and deep ravines marked the landscape. The rocky hillsides were largely bare, and a light soil existed only in the valleys. The Mississippi river flowed in

the same general course that it now occupies, but at a relatively lower level of from one to two hundred feet. The Lake Michigan basin was then a wide, deep valley, through which flowed a river draining an extended territory, probably including the valleys of Lakes Superior and Huron. From the southern extremity of the present Lake Michigan, it flowed in a southwesterly direction to its outlet in the Mississippi river. During the Quaternary age there were epochs of great cold, during which the vast accumulations of snow and ice in the north were unmelted by the short summer heat. Great glaciers were formed, which pushed down from the northward, covering most of this region except southwestern Wisconsin and northwestern Illinois.

This irresistible ice flood overran valleys and hills, and covered most of this area to a depth of perhaps several thousand feet. The hills were planed and rounded off, and the ice flood filled the valleys deeply with the detritus pushed before it and carried within it. Vast floods of water came from their melting fronts, and caused successive deposits of the various drift materials. The depths of these deposits in various places vary from nothing on the hilltops of the driftless area to three hundred and fifty feet at Janesville, Wis., in the old cañon of the Rock river.

The drainage system, which was developed prior to the glacial epoch, was greatly altered by the filling of valleys and the grinding down of the hills. The Mississippi river valley was partially filled, and its course in many places altered. The Lake Michigan river valley was filled to a point near Chicago, and the smaller drainage valleys of this area were entirely destroyed. The topography had also widely changed; in place of the rugged hills of the pre-glacial epoch, the present prairie land resulted. The drainage system which has since developed was largely marked out and modified by the effects of the ice and by the glacial floods resulting from its melting.

As the Lake Michigan glacier receded, it still rested over the present outlet of the lake, and the lake poured its waters down the present valley of the Illinois river in a flood far in excess of the modern river. The glacial floods also poured through the Mississippi valley, in each case excavating deep in the drift a wide valley, which the modern river but poorly fills.

Having thus briefly considered geological causes, the present geological conditions may be briefly reviewed. In the indurated rock formations, lines of exact demarcation seldom exist between the various strata. One stratum usually grades gradually into another. Changes in the controlling influence which modified deposition were usually not radical ones, but obtained only gradually.

A like condition applies to the character of a stratum throughout

its geographic extent: the conditions at one point might favor the formation of limestone deposits, while those more or less remote might be favorable to the formation of shale. Hence we find, if the same stratum be followed up, often even in very limited distances, that it may merge from a sandstone to a limestone, or from a limestone to a shale, and the reverse; or from a coarse-grained stone to one of finer and more impervious qualities. The more widespread and universal the conditions controlling deposition, the more uniform the character of a stratum throughout its extent. Hence the character of a rock deposit which we may expect to encounter in drilling is often highly problematic.

The underlying Archæan rocks have a slope in all directions from their outcrop in northern Wisconsin, being about 2,000 feet above sea-level at their highest outcrop. The superincumbent strata follow this general slope to a considerable extent. The surface also follows the general dip of the strata at present, as it has through all past geological ages, the older geological deposits being at their outcrop the higher; in travelling from the original Archæan nucleus in each direction, the traveller will descend in elevation, while he ascends in geological succession, as he approaches nearer the sea-level.

In considering the hydrological conditions of the various strata, it should be noted that all are water-bearing to some extent. Even where the ratio of absorption is comparatively small and insignificant, the cracks and fissures often play an important part. This area, like many others, is marked by an alternation in the position of rocks, varying largely in porosity, strata of high porosity frequently lying between those comparatively impervious. This variation is somewhat equalized by cracks and fissures, but the difference is still so marked as to create a great difference in the character of the flow.

The outcrop of these highly pervious strata, at high elevation on the watershed of the valley, gives rise to hydrostatic pressure within the strata, which is not wholly equalized by the transfusion of waters due to porosity or rupture of the strata. Hence in the lower portions of the valley these waters often come to the surface with considerable head through natural channels as springs or artificial channels as flowing wells.

Of the waters of this region the surface waters are the most obvious. It is found that the stream-flow amounts to from twenty-five to forty per cent. of the annual rainfall, depending on the modifying circumstances herebefore mentioned. From thirty to fifty per cent. of the rainfall is probably evaporated and utilized in plant growth, while the balance is imbibed by the underlying strata.

The stream-flow is largely derived from the ground water, which

flows toward the river with a surface slope more or less rapid in accordance with the porosity of the water-bearing strata in which it occurs. It is seldom that the water flows from the river to the land, even in extreme high waters; for the rivers, especially in high waters, carry much silt, and an outward current soon stops all pores by filling them and makes a practically impervious bed. This is the cause of failure in filter galleries which depend on the seepage of rivers for their supply. The streams sometimes flow through beds of sand and gravel, the visible stream being but a portion of the whole, including the invisible one which flows around and under it. This phenomenon is not largely developed in this area in any one stream, but is locally developed on most of the streams. The possibility of utilizing such ground waters by large wells, drive wells, or filter galleries will be readily understood. These beds of sand and gravel are sometimes continuous for great distances, and, being surrounded by comparatively impervious clay, they exist in what may be called underground reservoirs or lakes, or, as broad underground streams, flow through the gravel and sand toward their outlet in some distant watercourse. They derive their supply directly from the rainfall on their water-shed, the extent and character of which is usually difficult to determine, though on these features the availability of such sources for large water-supplies depends.

Surface and ground waters are liable to be contaminated by any organic filth on their watersheds. These waters are seriously affected by the settlement of the country. In many places where the population is still small and scattered these waters may be pure and satisfactory for domestic use. But along the streams where the larger cities are situated and in all thickly-inhabited localities the increase of population has rendered them unfit for use. The streams are now often used as the dumping-ground of waste materials, both liquid and solid, and, although stringent sanitary laws may in the main prevent gross pollution of these watercourses, it can never keep from them all of the liquid and solid accompaniments of a dense population. Waters once receiving organic matters retain them indefinitely, for, although the comparative amounts may be lessened by dilution, deposition, and bacteriological agencies, there is not a river long enough to entirely purify itself during its flow from source to sea, when once thoroughly contaminated.

The ground waters may, as a rule, be regarded as less liable to gross pollution than the open streams of the country, as they do not offer in such an unobstructed manner the temptation of the means of rapid disposal of waste. And, when only slightly polluted, the filtering qualities of the soil often afford a means of clarification, where the

matter causing pollution is not too concentrated or constant in supply. Such sources of pollution as vaults and leaching cesspools, however, often overtax the purifying powers of the soil, and cause a local pollution of the ground water even more dangerous than that of the polluted streams.

The fact of the limited occurrence of water in all strata has been already noted; hence, if the amount of water needed is small, the drill will find it in almost any deposit in amounts proportional to the porosity of the stratum or the occurrence of cracks and fissures in it. Outside of this general consideration, several deposits are especially important for their water-bearing qualities. Of these, the Potsdam sandstone is the most important. It has an outcrop of about fourteen thousand square miles, affording an ample watershed. From this source are derived numerous artesian and deep wells, which have been developed throughout the extent of the outcrop. The St. Peter sandstone is next in importance in this area as a source of water. Its outcrop extends over about three thousand square miles, and in a large part of this area it lies above the Potsdam and is first encountered by the drill. Its elevation is, however, less than that of the Potsdam, and hence its waters have not usually as great a head, and consequently do not as often furnish flowing wells.

The drift deposits are sometimes so extended that they may produce all phenomena observable in the lower strata, such as artesian flows and copious springs at numerous points within this area. Many of the other deposits of this area may be made available as sources of water-supplies by driving infiltration tunnels through their mass, the tunnels being of sufficient extent to produce the necessary amount of water.

The deep and artesian waters often flow through miles of material and are effectually filtered from all organic contamination, and, if unpolluted at their outlet, are organically pure. Wells drawing their waters from such sources offer a supply second to none in organic purity and freedom from all risk of contamination. While the deep waters are organically pure, they are very likely to contain much larger percentages of inorganic salts than surface waters.

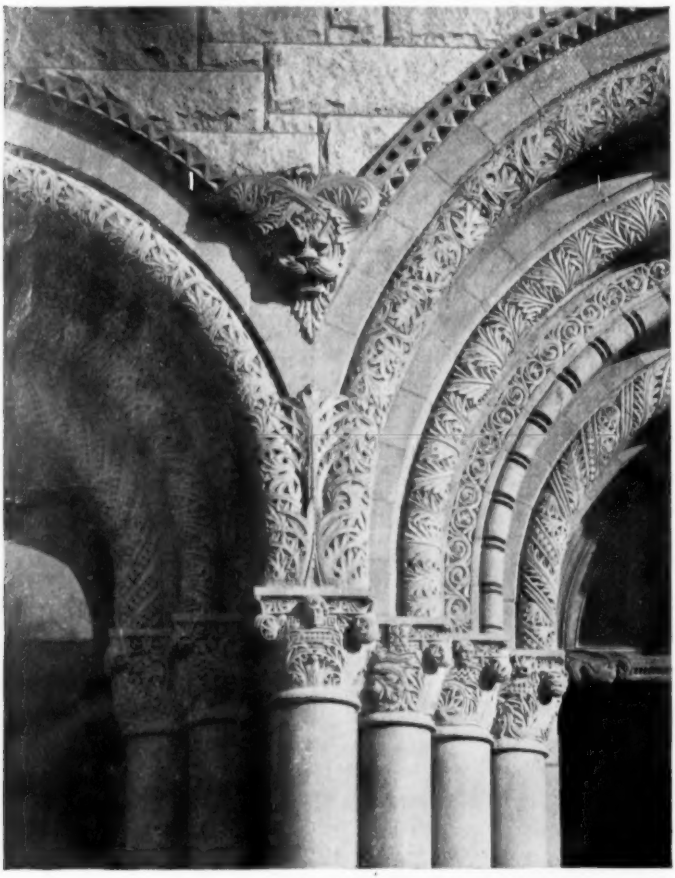
Enough has been said to show that, in searching for the most favorable water-supply, it is important that local conditions be ascertained and local geology and topography understood, in order that all possible sources may be known and the probable cost of obtaining waters from each and the probable quality and quantity of the same may be rightly judged.

ARCHITECTURAL SCULPTURE IN AMERICA.

By Russell Sturgis.

THERE have been a few attempts to apply a new and living architectural sculpture to American buildings, and these attempts seem to be worthy of mention. But, architectural sculpture being a term of large application, let it be confined in this short article, to the consideration of sculpture of a purely decorative character, excluding statuary and even sculpture in relief, when representative and expressional even more than decorative. Thus the six statues by Mr. J. Masey Rhind, which we are all anxiously waiting for, and which are to be set up on the front of the American Surety Building at Pine street and Broadway, New York, will not come within the limits of this paper. And, on the whole, it will be best to exclude also the figure sculptures by Mr. Martiny on the front of the Mail and Express Building on Broadway; although these, as terminal figures, are rather architectural than expressional in purpose. The decoration of such buildings as the Walker Art Gallery at Bowdoin College, by means of statues and busts, selected for their high sculpturesque importance and placed in niches, is, of course, outside of the whole subject of architectural art. How fully-realized and perfected sculpture has been and may be used to adorn buildings is a subject large enough, important enough, and puzzling enough to be treated by itself. The question before us now is the value of such architectural sculpture as, for instance, the late H. H. Richardson put upon so many of the buildings of the last ten years. We need not consider whose power of design it is that these sculptures show. Nowhere in the work ascribed to a modern architect can the outsider feel sure of individual claims to the merit or demerit of a design; nobody

CAPITAL FROM HARVARD LAW SCHOOL.
H. H. Richardson, Architect.



PART OF MAIN PORTAL, CITY HALL, ALBANY, N. Y.
H. H. Richardson, Architect.

but the *habitués* of the architect's office can know anything about this matter of authorship.

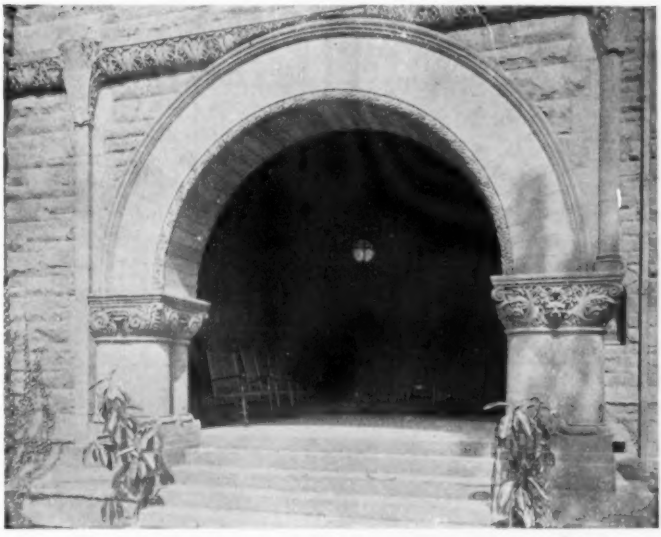
The sculpture to be fairly attributed to Mr. Richardson is, then, Byzantine in general character, in nearly every instance. There is none of it in New York city; but in the capitol at Albany it is abundant, and it is to be seen in the Harvard Law School at Cambridge, the Pittsburg court house, the Albany city hall, a memorial fountain at

Detroit, and buildings in Washington, Boston, and small towns in Massachusetts. Its characteristic is the crowding of the surface with foliated ornament in very low relief. No space more than an inch or two wide or high, of the panel or frieze or other decorated member, is without some part of a leaf or of a masque or boss or volute forming part of the leafage. All the leafage is modeled upon the Byzantine type, found in the capitals of churches of the fifth and sixth centuries, in the spandrels of Saint Sophia, and in the relief and pierced panels of the same epoch. The capitals of the American work, especially those of single columns of moderate size, are often very closely studied from the originals at Constantinople, or Ravenna, or Venice. The somewhat narrow string-courses and the abaci of the columns and clustered piers are often, as at Chicago and Washington and Detroit, very strictly Byzantine. So are frequently the secondary capitals, as they might be called; sculptured blocks set upon the abaci of the capitals proper and forming impost or terminating a lintel. This foliation is, of course, made up of that modified acanthus leaf which the fifth-century Greeks enjoyed so heartily. There is no lovelier decorative carving than this, in its original form, delicately worked in fine-grained marble; and it may almost be said that the American works is a worthy continuation of it. Certainly it would be hard to find modern architectural sculpture in large quantity more fitted to its

CAPITALS IN THE HARVARD LAW SCHOOL, CAMBRIDGE, MASS.
H. H. Richardson, Architect.

place and its requirements, or of greater individual and independent merit. When, as in the Harvard Law School and again in the law library of the Albany capitol, the type is somewhat changed; when the leafage becomes less sharp, and the relief a little bolder,—something of the original charm is lost. The Byzantine delicacy is gone, and the Romanesque boldness which ought to take its place is not there. Mr. Richardson had made more than one journey in the south of France, and the somewhat feeble sculpture of the Romanesque buildings there, as at St. Gilles and at Arles, had perhaps influenced his feeling in regard to open-air sculpture. Certainly the transition from Byzantine delicacy to northern vigor might have been better managed, and the sculpture of Angoulême, Poitiers, Limoges, Clermont-Ferrand, and St. Jouin de Marnes might have served as prototypes. It is not unreasonable to ascribe to the authors of this modern sculpture the wish and the intention to draw toward northern Romanesque, because the buildings in which their sculpture is found are, in other parts of their decorative design, full of the suggestions of the Romanesque architecture of southern and southwestern France. Indeed, as to the sculpture alone, the somewhat deeply carved roll-mouldings of the Albany city hall are entirely northern in spirit. Moreover, the use of heads, whether of grotesque or of graver design,

CHIMNEY PIECE. CARVED BY HEIDENREICH & STEPHAN.
C. F. Schweinfurth, Architect.

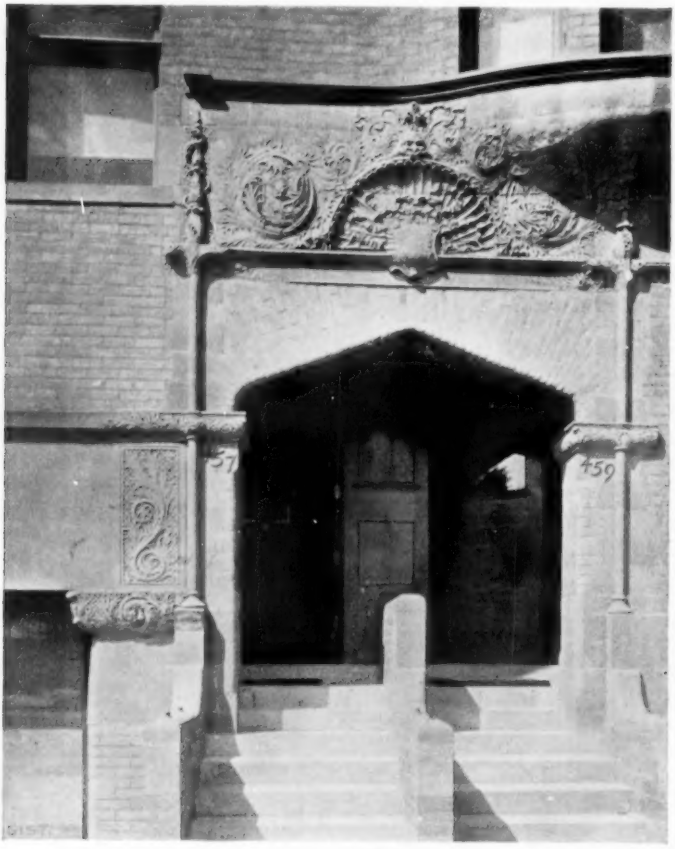


ENTRANCE TO A RESIDENCE IN DETROIT, MICH.

C. F. Schweinfurth, Architect.

as center-bosses in large capitals is entirely northern in spirit: for the Venetian use of heads in similar places is primarily descriptive and emblematical.

Although the Richardson decorative sculpture loses much of its charm as it passes from Byzantine flatness and sharpness into Romanesque deeper shadows and more rounded forms, the sculpture of essentially Gothic character, as in the North Easton town hall, is often extremely vigorous and of immense value to the building. No better instance can be offered of the charm which may be imparted by the use of sculpture to an otherwise fairly good design than the effective relieving of the large capitals of that building upon the dusky walls behind the arcade. In a building in Albany,—a dwelling house fronting on Washington Park,—having a narrow front with a large segmental arch over a loggia and a smaller one for the entrance doorway, sculpture of a somewhat independent character is sparingly applied with surprisingly good result. The general character of the architectural forms and of the sculpture is, as a whole, that of the earliest French Renaissance with the florid Gothic feeling still strong in it. More than most American specimens of decorative sculpture, this tells upon the whole design of the front.



RESIDENCE IN DETROIT.
Mason & Rice, Architects.

Mr. C. F. Schweinfurth, of Cleveland, has of late, taken up the Richardson system of leafage, and, in different buildings, has modified it in two distinct ways. In some cases, as in the residence of Col. Merriam in Minneapolis, the Byzantine acanthus is treated, at once, with broader leaf masses and with sharp and prickly leaf points. A photograph shows a carved panel above a fire place in Cleveland, in which a scroll is carried by and spread upon a hedge of thistles; and one who studies these thistle leaves will see what forms

perhaps some part of the inspiration of the more conventional leafage named above. So, in a stone mantel-piece carved by Messrs. Heidenreich and Stephan from Mr. Schweinfurth's design, an escutcheon is charged with thistle plants in high relief, and the large surfaces on either side are filled with scroll-work, also in relief, in which the Byzantine acanthus puts on a thistle-like and prickly character, in conformity with the central motive. Other work ascribed to Mr. Schweinfurth is in the way of more frankly conventional German Romanesque, like that of Bamberg, though this also is evidently the result of careful thinking out; in other words, it is *designed*, which our contemporary sculpture much more often is not. In the Christian Association Building at Cleveland, this formal carving is combined with fully-realized sculpture of human subject in the porch, and the effect is not objectionable, although the scale of the parts has not been perfectly preserved.

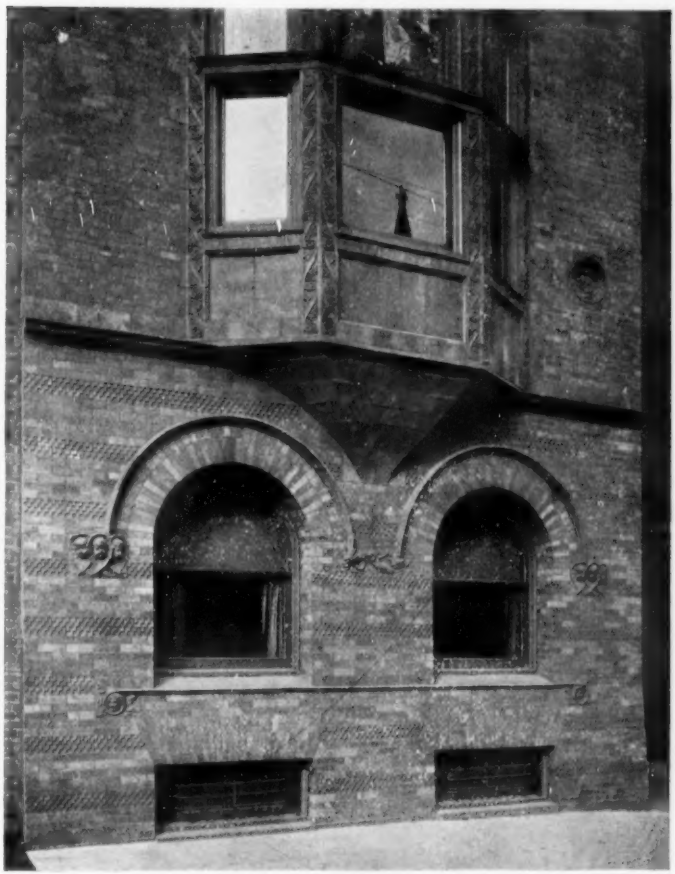
Messrs. Mason and Rice have done some work at Detroit, in which the Richardsonian Byzantine has been used with great boldness in combination with shields and fluttering scrolls. Moreover, in a Detroit church, a great deal of this sculpture has been used in combination with the peculiar inlay of sandstone of different colors, like a mosaic of gigantic scale,—the inlay so characteristic of some beautiful French Romanesque, as in Notre Dame du Port of Clermont-Ferrand.

FROM A HOUSE IN NEW YORK.
R. H. Robertson, Architect.

ENTRANCE TO THE ART CLUB, PHILADELPHIA, PA.

Frank Miles Day, Architect.

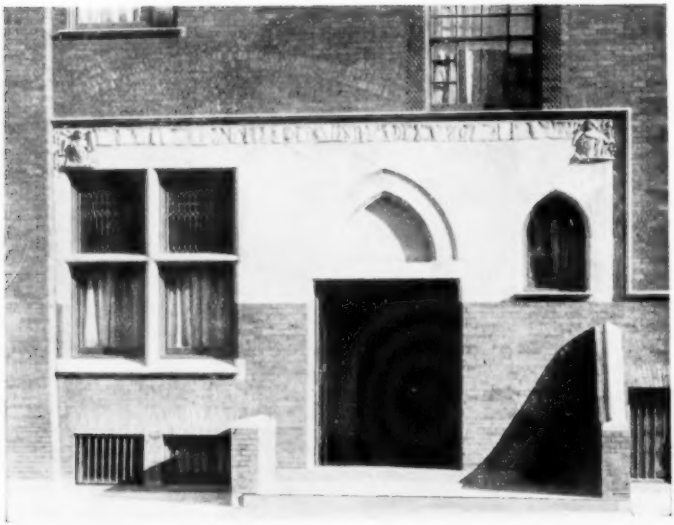
The sculpture of the wall-cornice, especially that of the low round towers which flank the porch, is a remarkable piece of bold designing, in which the deviations from the Richardsonian type are very decided, as, for instance, in the much greater relief and deeper shadows of the foliated ornament. It should be noted, though the subject cannot be discussed here, that Boston architects who are, in a sense, the heirs of Richardson's architectural reputation have produced carving which

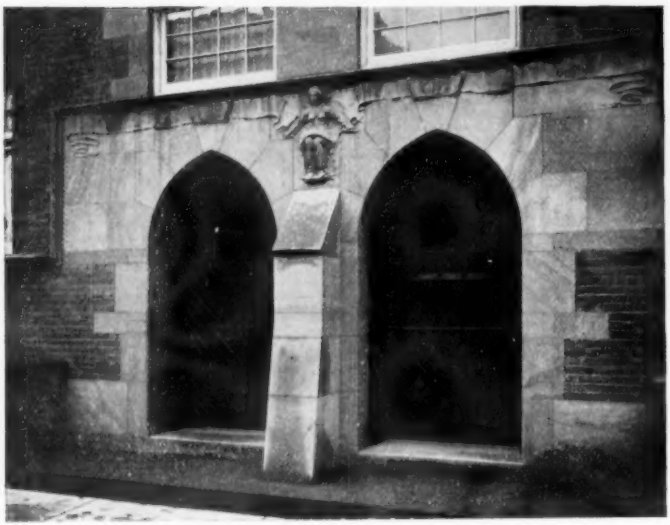


A CHURCH CLUB HOUSE, PHILADELPHIA, PA.
Wilson Eyre, Jr., Architect.

should be compared with that of his own time, in any thorough study of this subject.

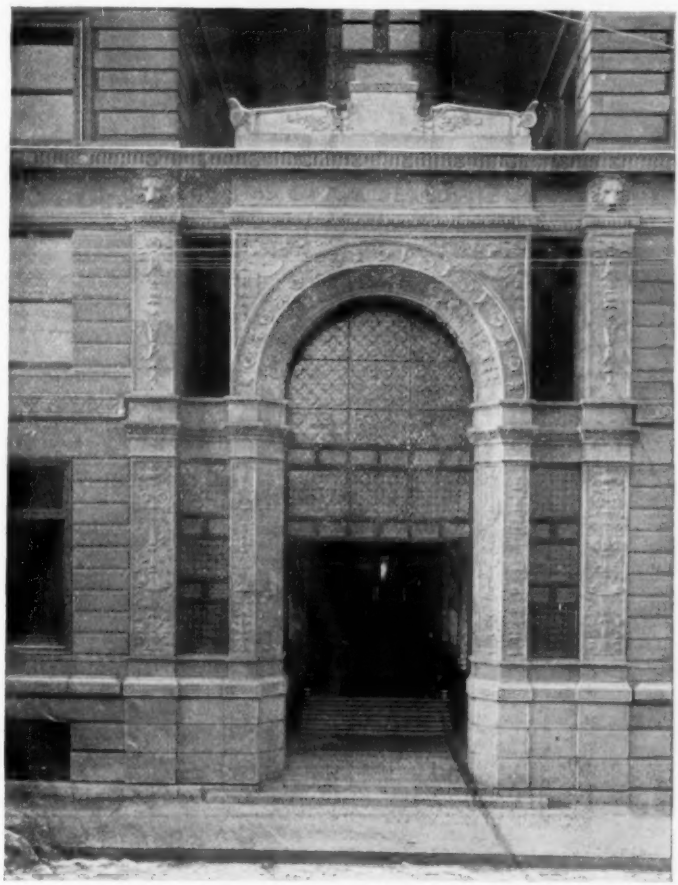
Mr. R. H. Robertson of New York has been the means of giving us a certain amount of architectural carving. Sometimes this appears in buildings not otherwise very notable, whether for cost, or massive construction, or general architectural display. Thus, in the Church of the Messiah in Brooklyn, built of brick and not striking





HOUSES IN PHILADELPHIA.
Wilson Eyre, Jr., Architect.

in mass, or in proportion, or in general decorative effect, a great deal of remarkable sculpture is applied to the portico of entrance and the basement of the tower, and some to other parts of the building. This sculpture has an originality of conception which it is hard to find matched in contemporary work; it seems to have been newly designed,—work of our own time. A New York city house at the



DOORWAY IN THE NEW YORK LIFE INSURANCE BUILDING, ST. PAUL, MINN.

Babb, Cook & Willard, Architects.

corner of Fifth avenue and Sixty-third street, and bearing the date 1884, has sculpture upon which the same criticism may be passed. The sculpture which fills the panel in the bay window, and that which invests the high and massive corbels of the same bay-window and the stops of the coves above them, are admirably conceived. If this sculpture is, as it seems to be, a work of our own time, those

DOORWAY IN THE NEW YORK LIFE INSURANCE BUILDING, MINNEAPOLIS, MINN.
Babb, Cook, & Willard, Architects

who are responsible for it deserve the thanks of a community which must be getting tired of carving taken bodily from photographs of ancient work.

In some of the sculpture ascribed to Mr. Frank Miles Day similar freshness and apparent originality of treatment are perceptible. There is to be noted in one and the same group of details—as, for instance, in the doorway of the Art Club of Philadelphia—a mingling of sculptured ornament of a recognized ancient style and closely copied from its remains, with the design of more modern treatment, of which it has been a pleasure to speak. A small dwelling-house in Philadelphia,

CAPITAL FOR THE GUARANTY BUILDING, BUFFALO, N. Y.
Louis H. Sullivan, Architect.

where an arched window fills nearly a whole front of the ground story and a narrow square-headed doorway with a circular light above it completes the group, offers an admirable specimen of Mr. Day's delicate work. Everyone who has to do with decoration knows that the difficult thing to secure is the decorative part. Twenty carvers can model or cut interesting leafage, studied rather closely from nature, and, of these twenty, three or four can carve grotesque and spirited animal form, where one, or not even one, can fill a small or a large panel with scroll-work or diaper in such a way as to give it decorative effect. The house we are considering,

BRONZE DOORS AND GATES OF THE WAINWRIGHT MEMORIAL, ST. LOUIS, MO.
Adler & Sullivan, Architects.

which is in Walnut street near Sixteenth street, gives evidence that the designer of its sculpture has faced this difficulty, and has allowed his carvers the naturalistic forms which they best understand.

Mr. Wilson Eyre, Jr., has been working in the same direction, using entirely natural forms with conventional line-work and scroll-work and shell-work as mere frame and setting for it. Small houses

of his in Philadelphia are adorned with human subjects, modeled with the full modern sense of truth to nature, and yet made to serve as architectural adornment. If any one continues to doubt that Gothic designing might still be good Gothic, even though the sculpture were faithful to nature, in the modern sense; if the example of Louvain town hall and the great church of Abbeville, or even that of the cathedral at Reims, should not be enough for him,—these pieces of Mr. Eyre's creation would certainly suffice. Particularly to be admired is the square doorway in Walnut street, Philadelphia, where the number 2121 is carved on a scroll which fills the space between two corbels, or, in other words, occupies the whole length of the lintel which these corbels support. Each of the corbels is charged with a seated figure holding a shield. A church club-house has groups of cherubic heads forming bosses from which spring the hood-mouldings of arches. This house, which is in Twenty-second street, Philadelphia, and bears the date MDCCCLXXXVIII has, beside its entrance doorway, a small round window framed by a festoon and two *putti*, this being certainly of less originality of conception than Mr. Day's roundell, but delicately modeled and delicately carved. Several of Mr. Eyre's houses have long and nearly straight scrolls carved at the head of their ground-story wall. These scrolls have supporters in the form of draped female figures of great delicacy, and the combined design is at once ingenious and satisfying, and not at all too quaint to be delightful.

The carved work added sparingly to the buildings of Messrs. Babb, Cook & Willard of New York is remarkable in this respect,—that the accepted forms of fifteenth-century Italian arabesque have been taken as the prototype of what is essentially original designing in the best sense. This is as much as to say that the designer has adopted the Italian renaissance as his style, but has had an ambition above mere copying and an ability which seconds his ambition and has given to his work the stamp of real decorative excellence. The buildings especially under consideration are those of the New York Life Insurance Company at Montreal, at Minneapolis, and at St. Paul; but the same judgment would apply to other work of this firm, which cannot be specified here.

The above catalogue is far from exhausting the material, even that which is easily accessible. It includes none of the very valuable decorative sculpture of the late firm of Adler & Sullivan of Chicago, which is applied not merely to the exteriors of buildings and their important interior spaces, but also to metal work and other fittings, with singular freedom and appropriateness of design. It includes nothing in terra-cotta or moulded brick. No mention is made of those buildings in

which the sculpture, though in itself fine, is badly placed and fails to aid the general design ; or of the more numerous instances of carving which helps the building well enough, though in itself frankly copied from ancient work. The important thing seems to be to insist upon the existence in our cities of a certain amount of really original and, on the whole, admirable decorative sculpture. Students of architectural art who note with surprise the entire absence of sculpture from a building as admirable in its decorative character as the Law School of Columbia College or the group of seminary buildings at Park avenue and Sixty-ninth street ; who miss such sculpture from the stately and massive Dakota building west of Central park, or from the spirited and fantastic Berkshire in Madison avenue, or from the refined Yosemite building in Park avenue ; who wonder how such a church as St. Agnes's Chapel, of Trinity parish, should be carried to completion without a scrap of carving, or how St. Thomas's, or the Collegiate church at Forty-eighth street, should have only the perfunctory capitals and crocketts of the style ; who cannot endure that no sculpture should be given to such sumptuous private houses as half a dozen in upper Fifth avenue,—such persons may be comforted by the knowledge that a great deal of good sculpture of the decorative sort has come into existence within the decade. It is scattered thinly over a vast tract of country, but it is there ; and the important question now is how there can be made possible the production of more, very much more, of it.

THE FREE-PORT OF COPENHAGEN.

By P. Vedel.

LAST summer, when the German emperor opened the North-East Sea canal, greeted by the cannons of all the navies in the world, little Denmark was expected to tremble lest the Baltic trade should be diverted from the sound to this new route. Nothing of the kind occurred, however. Anticipating that some danger might arise from this source, the Danish government had built a new harbor at Copenhagen, and, half a year before the inauguration of the canal, Copenhagen Free-port had been formally opened. No flourish of trumpets or salvo of artillery announced this fact to the world, for it was not a military undertaking. The government, the city, the board of trade, and the people had united in a determination to make the Danish capital more than ever a distributing center for the Baltic. And, with united efforts, they had built a harbor second to none in the world and provided with the newest and most improved accommodations for the loading and unloading of vessels, storage of goods, etc.

A *free-port* has been described as a piece of foreign territory in the inland. It is a harbor basin with a certain land area, surrounded on all sides by high fences which constitute the boundary between the free territory and the inland. Within the enclosed area vessels can unload their merchandise and store it in the warehouses free of all tariff duties or inspection of custom-house officers. Factories may be located there and may use imported, dutiable raw materials without paying any duty; they may export their manufactured products, or send them inland; in the latter case the duty must be paid. Whatever passes the boundary line must pay all dues as if coming from a foreign country. But what is stored in transit only, what is lost by leakage and evaporation, waste of raw materials from the factories, etc., pay nothing. The freedom of a free-port usually refers to tariff duties only; but in Copenhagen it is really a free harbor, all harbor dues having been done away with. It is, therefore, one of the cheapest harbors at which a vessel can call. The Copenhagen Free-port administration in a recent pamphlet (French), gives an account of the progress of the work and the different constructions of which the writer makes free use.

The annexed diagram shows the new harbor. The boundaries of the free territory are indicated by heavy lines. Outside these, or belonging to the inland, are the New Limekiln dock, the Pleasure Craft basin, and the east quay of the eastern pier. The free-port consists of a north basin, a central basin, and a south basin, the depths of water

being from 24 to 30 feet, which is as much as in the North-East Sea canal and sufficient for the largest vessels. Between the central and the south basins is a berth for the steam ferries which connect Sweden with Denmark. The total land area enclosed is 89 acres, with a water area of 59 acres and a docking 12,350 feet long. It is enclosed by a double iron fence 7,620 feet long; the outer fence is 9′ 3″ high and the inner 8′ 5″, and they are 6 feet apart, thus forming a patrolway for the custom-house officials and preventing smuggling. A railroad track is fenced off through the old fortress and the park, so as to connect the free-port with the old harbor of Copenhagen. The park around the harbor for pleasure-boats, and east and north of the fortress, covers about 40 acres. Its walks are carried on bridges over the railroad tracks, and the seashore promenade extends out on the eastern pier over the roof of a low warehouse. To facilitate the entrance and departure of barges from the free-port, as well as to produce a light current through the latter, a *barge-canal*, 300 feet long by 30 feet wide with 9 feet of water, is cut through the south end of the east pier. It is crossed by five bridges, and closed at night by chains.

The free-harbor law was passed in March, 1891, and work commenced at once. The Copenhagen Harbor administration excavated the basins and dredged the entrance channels, built breakwaters, quay-walls, fences, roads, and sewers, and graded the ground. The Copenhagen Free-port company, which holds the privilege of operating the free-port for eighty years, built the warehouses, grain elevators, power house, and administration building, laid the railroad tracks and water-mains, and furnished the cranes, electric installation, etc. The railway board constructs the pier and berths for ferries, with depot etc.

The north basin was dredged by powerful chain-bucket dredges, but the *excavation* of the central basin and south basin was done by exclusion of the water. Coffer-dams were built out in the sea around the territory, which was originally covered with water; by a cross-dam near the ferry-berths the central basin was separated from the south basin, and each of the two sections was thus worked independently of the other. The south section covers an area of 49½ acres, and was pumped dry in 68 days; four centrifugal pumps delivered in that time 163,000,000 gallons of water. After that one pump worked daily 11¼ hours to keep the water out. The north section covers 61 acres; three centrifugal pumps pumped in 20 days 596,000,000 gallons, and after that 16½ hours' work of one pump was needed daily to keep the water out. On the south section, where the contract price was 25 cents per yard excavated, 670,000 cu. yds. were moved in 419 working days, or 1600 cu. yds. per day (maximum per day, 3,500 cu. yds.); the digging was done by a chain-bucket excavator of the Lubeck type. On

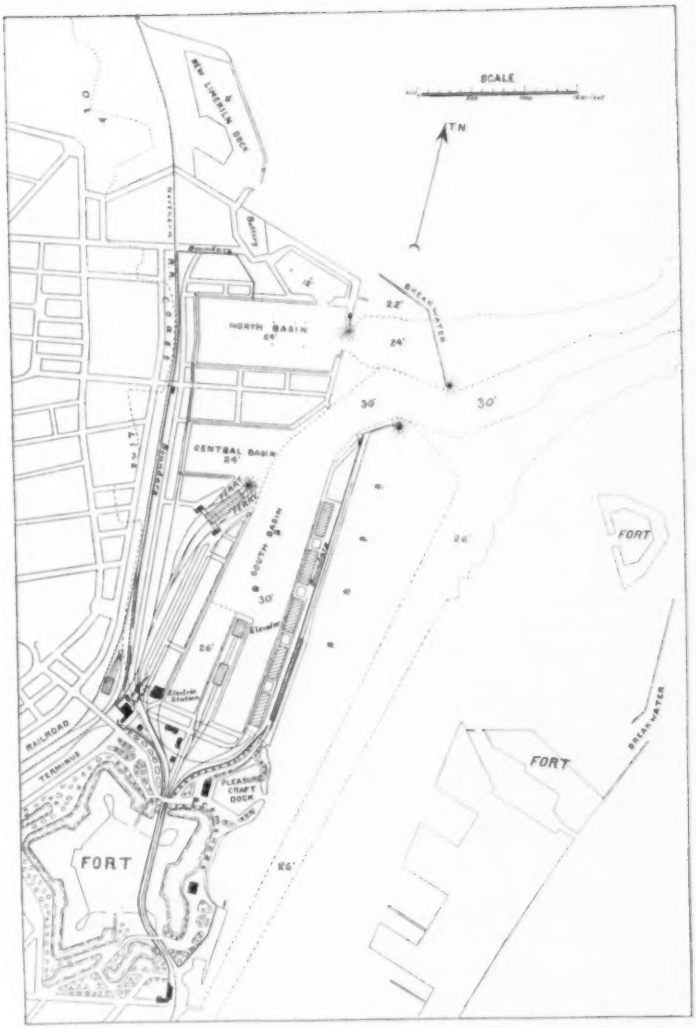


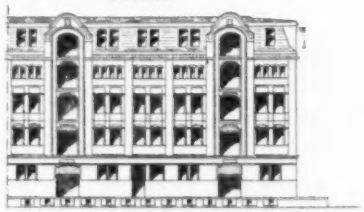
DIAGRAM OF THE FREE-PORT. THE BOUNDARY IS INDICATED BY THE HEAVY LINE.

the north section the contract price was 23 cents per yard, and 765,000 cu. yds. were excavated in 357 working days and 50 nights, or 1,880 cu. yds. per day (maximum in 24 hours, 5,890 cu. yds.); the digging was done by one Lubeck excavator with a daily average capacity of 1,159 cu. yds. and one Belgian chain-bucket excavator with a capacity of 697 cu. yds. in 10 hours. The soil consists of clay and sand with boulders and fragments of the underlying limestone bedrock.

Three types of docking have been used. Wooden bulkheads of a very substantial construction were built so that the part above water could easily be renewed. For protection against teredos the piles are all sheeted with iron plates. In 24–26 feet of water the contract price is $36.40 per lin. ft., and about 710 feet B. M. enter into the construction per lin. ft. The solid quay walls consist of concrete from the bottom to 3′ 9″ below water, and granite masonry above. On the backside the concrete forms arches between counterforts, and through the masonry is formed a tunnel which serves as a receptacle for the gas- and water-pipes, electric-light wires, electric-power cables, etc. The wall is 38½ feet high, has an average thickness 3·10 of its height, and contains 452 cu. ft. per lin. ft. Its cost was $110.73 per lin. ft. Every 260 feet it has a vertical joint through its whole height; this was done to prevent it from cracking, as the ground was found to settle unevenly. The third type is a combination of the two first,—*i. e.*, the upper part of the masonry wall resting on the under part of the wooden wall. Its cost was $76.28 per lin. ft. In order to protect the timber against the teredos, Monier plates (6′ 10″ × 3′ 3″ × 2⅓″ with net work of 0″.20 and 0″.28 iron wires, B. W. G. No. 6 and No. 2) were fastened to the front of the main piles, and the space between them and the planking was filled with concrete. At the foot of the piles a row of sheet piles was driven, and a toe of concrete was formed to prevent the earth from being washed out by steamers moving their propellers. Not until all the walls were built was the water let into the central and south basins through a 12″ pipe and a 16″ pipe. It took 39 days and 457,000,000 gallons of water to fill the two sections in this manner.

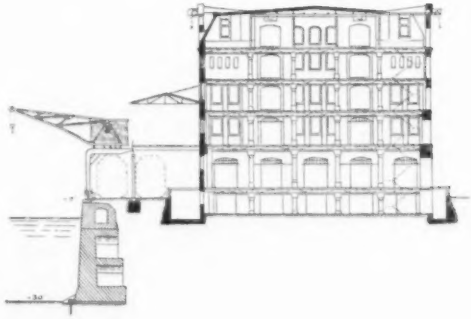
The warehouses are all fire-proof with I beams and cast-iron columns covered with Monier plates, and asbestos layers between floorings. They are 309′ × 82′, some of them two stories and others five stories high. The basement is 8′ high, first floor 14½′, second 11⅓′, third and fourth 10¼′, and the top story 11⅓′. The first floor is calculated for a load of 460 lbs. per sq. ft., the second, third, and fourth floors for 300 lbs., and the fifth for 200 lbs., the weight of the floor not included. Each warehouse has stairways, six elevators, and six cranes, all worked by electricity. At a level with the second floor an

Elevation



FIVE-STORY WAREHOUSE

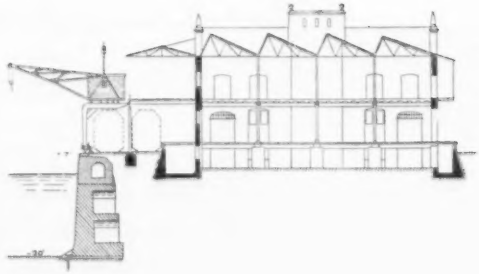
Section

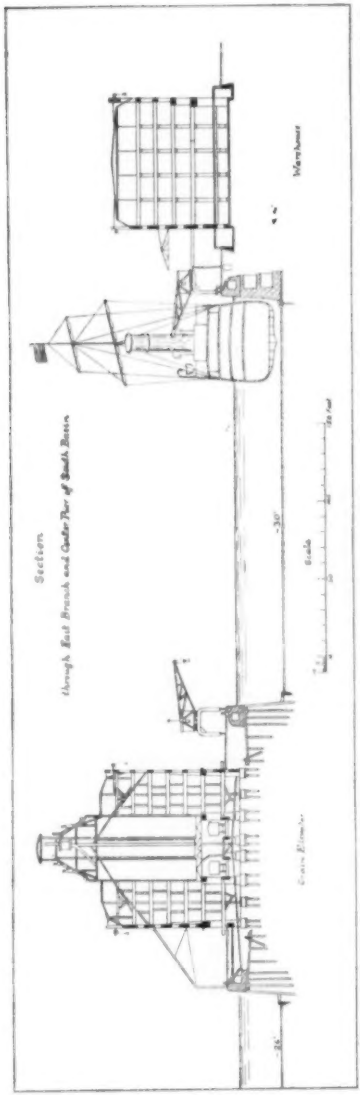


Elevation

TWO-STORY WAREHOUSE

Section

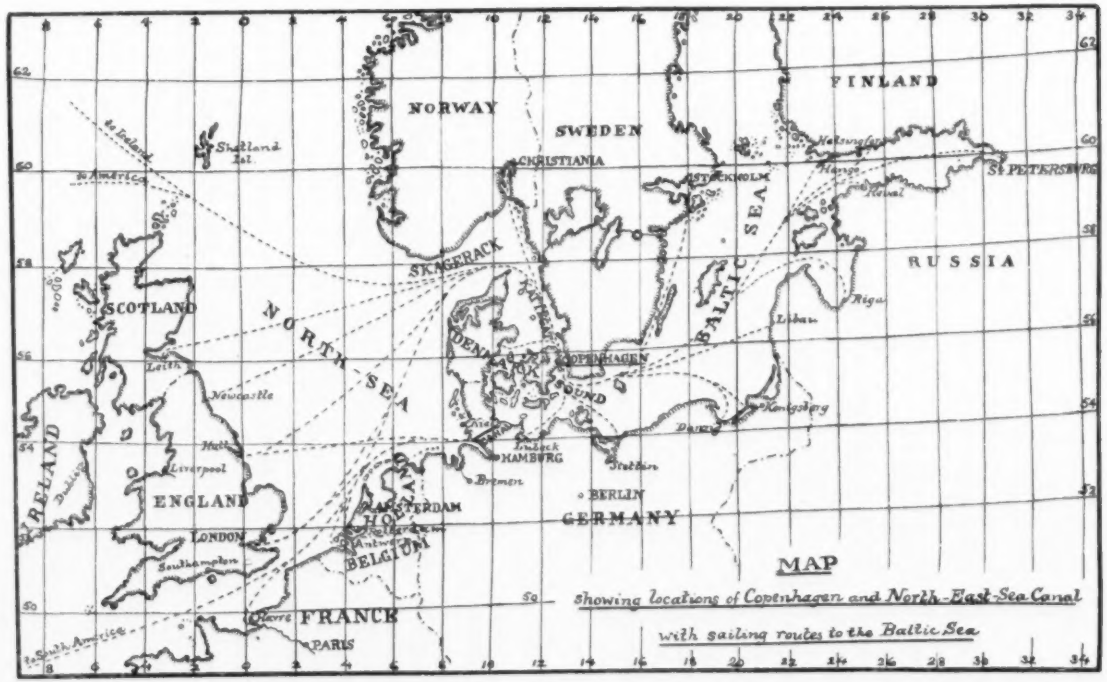




elevated structure on the quay-side of the warehouses connects them so that goods can be transported from one to another by truck-cars.

On the central pier is a grain elevator 164′ × 102′ × 128′ high. It is longitudinally divided into three sections. The two outer ones have a basement and seven floors for storage of grain, whereas the middle section has thirty-six wooden bins in three rows, 67′ high, each group of eighteen being surrounded by Monier walls. This warehouse is provided with the most improved machinery for handling and storing grain; railroad cars can run in under the bins, and it is calculated to unload from 2,000 to 2,500 tons within 36 hours after the arrival of the vessel at the quay.

The harbor entrance is well protected by breakwaters and the small islands which enclose the inner roads of Copenhagen. The east breakwater between the forts is built in 10 feet of water, of riprap and piles. The north breakwater, which has attracted wide attention and was described in *Engineering News* (July, 1894), is built in 10 to 24½ feet of water. It rests on a sand and riprap foundation, and consists of one or two tiers of concrete blocks below water and a solid granite wall to about 6 feet above water. It is on the outside backed by sand and gravel, with the slope protected by loose stone. The blocks are 10′3″ high by


NORWAY
SWEDEN
FINLAND
CHRISTIANIA
STOCKHOLM
ST PETERSBURG
SKAGERRACK
KATTEGAT
BALTIC SEA
RUSSIA
SCOTLAND
NORTH SEA
DENMARK
COPENHAGEN
SOUND
Riga
Libau
Hamburg
Lübeck
HAMBURG
Bremen
Stettin
BERLIN
GERMANY
AMSTERDAM
HOLLAND
BELGIUM
ENGLAND
IRELAND
LONDON
Liverpool
Newcastle
Leith
Hull
Southampton
Shetland Isl
Cherbourg
FRANCE
PARIS
MAP
showing locations of Copenhagen and North-East-Sea Canal
with sailing routes to the Baltic Sea

10′8″ wide by 8′3″ long. In order to make them light enough to be handled by the floating derrick, and heavy enough, when in place, to resist the waves and the ice thrust, they were made hollow, and afterwards filled with sand and stone. Thus, when handled, their weight was 39 tons, whereas in place they weigh 53 tons. Their two sides, transverse to the length of the breakwater, are formed of Monier plates (2¾″ thick with network of 0″.20, 0″.28, and 0″.38 iron wire) placed one foot from the end of the two other sides; the space thus formed between two adjoining blocks is filled with a special little keyblock. The construction of this breakwater took nearly three years; in it were used 265 large blocks; the greatest number put in place in one day was six.

A notable feature in all the constructions is the extensive use of Monier plates of iron network embedded in cement mortar (1:3, which has the same coefficient of expansion as iron).

The entrances and channels which lead to the free-port are all marked with lights and buoys, and vessels can make the harbor in any stress of weather. The sound has no tides, and the depths there and in the basins are sufficient for the largest merchant vessels afloat. A moderate current prevents the formation of ice, and the sound is hardly ever ice-bound; in fact, during the last fifteen years a steamer has made at least one daily trip between Copenhagen and Sweden.

It is certainly a costly experiment to build such a harbor and suddenly increase the existing dock frontage by about 33 per cent., or three miles. It costs still more to make it a free-port and build guard-houses at all the entrances, as well as custom-houses and fences, and maintain a large staff of custom-house officers to watch the boundary night and day. But the nation has determined, at any cost, to make Copenhagen the Hamburg of the north, where goods may be stored and whence they may be distributed to surrounding countries by vessels suitable for the shallow waters of the Baltic. And now it offers to commerce every inducement: a commodious, deep, and practically ice-free harbor, provided with the most improved machinery for the quick despatch of vessels; modern, fire-proof warehouses, grain elevators, provision stores, etc.; and freedom from all harbor dues and customs dues, with all the delay and annoyance connected therewith. It is safe to say that not a very large percentage of the 16,500,000 tons that now annually pass the sound will take the new route through the Kaiser Wilhelm canal. The old wooden sailing vessels of the large Swedish, Russian, and North German timber fleet cannot afford to pay the high canal dues. Nor would any vessel bound for the United States or Canada, without any saving in distance, prefer the dangerous navigation of the Elbe and the English channel to rounding the Skaw and the north of Scotland.

OPPOSITION TO INVENTIONS.

By William C. Dodge.

ONE of the most remarkable things in the history of mankind is the opposition to the introduction of inventions and improvements which has existed from the earliest times, and still exists to some extent.

From the time when the earth was believed to be flat, and Galileo was denounced and imprisoned for asserting, in accordance with the theory of Copernicus, that the sun was the center of the planetary system, and that the earth had a diurnal motion of rotation, this opposition to new ideas has existed, and been manifested in the grossest outrages upon, and persecutions of, the originators and advocates of the new ideas. This has been true of inventions and improvements in the arts and sciences, as well as in governmental and religious improvements or reforms.

Much of this was due to the existence of the prevailing doctrine of the "divine right" of rulers and the arbitrary power exercised by them, and to the claim of superior wisdom and infallibility made by the then dominant church, supplemented and rendered possible by the ignorance and helplessness of the masses.

Besides, human nature seems to be subject to the same law as moving bodies; it moves always in a direct line when once set in motion, unless interfered with by a power sufficient to deflect it from its course. In the arts and sciences, as in politics and religion, men prefer to remain undisturbed, and naturally resent any interference with their settled beliefs and habits. They look with suspicion on new suggestions or ideas, and especially such as, in their ignorance, they think will interfere in any manner with their present interests; and hence the tendency to continue in the old ruts, and violently oppose improvements or changes, and to denounce inventors as "cranks."

History shows that the great improvements in the arts and sciences have had their development only since free governments have been established, and general education introduced; and it is where these exist in their greatest perfection that the greatest advance has taken place.

In the United States, where there is the greatest freedom in governmental and religious matters, there has been the greatest advance in inventions. The growth and development of our manufacturing and agricultural interests, which is due to inventions fostered by our patent system more than to any other cause, has been marvellous, and

excites the astonishment of the world. Under the benign influence of this system, in a single century, we have grown from a cluster of scattered settlements, mostly along the Atlantic seaboard, with a population of less than four millions, to a compact and powerful nation of nearly seventy millions; have increased our national territory from 830,000 to 3,314,220 sq. miles; have subdued the forests and built up the whole country from ocean to ocean; and have built more miles of railroad, and established more post offices, than all other nations combined. We have grown and prospered as no other nation has, until to-day we do one-third of the world's manufacturing, one-third of its mining, one-fifth of its farming, and possess one-fifth of its wealth.

With such an illustration of the benefits of our patent system, one would suppose that opposition to inventions would long since have ceased; but unfortunately, while it has greatly diminished with the growth of intelligence and universal education, it still exists.

As illustrative of this spirit of opposition, it may be interesting to cite a few instances.

When, in 1807, Papin of France, the inventor of the digester in universal use for paper-making and many other purposes, and also of the lever safety valve, made a small steamboat and ran it down the river Fulda, the ignorant boatmen, who, like some of the laboring men of the present day, thought it would injure their business, seized and destroyed it.

So too, when Jonathan Hulls patented his steamboat in England in 1736, he was laughed at and ridiculed in every conceivable way. One paper published the following doggerel in reference to him:

Jonathan Hulls,
With his patent skulls,
Invented a machine
To go against wind and stream,
But he, being an ass,
Couldn't bring it to pass,
And so was ashamed to be seen.

When Jacquard invented his loom, which was so wonderful that the great Arnot, French minister of war, caused him to be brought into his presence and said to him: "Are you the man who can do what the Almighty cannot,—tie a knot in a stretched string?" there was the strongest opposition to its introduction, culminating in a mob of the silk weavers, who took it from his house into the streets, broke it up, and burned the fragments.

It was the same with Hargreaves in England, when he invented his spinning-jenny in 1763. He was persecuted by his fellow workmen, who seized his machine, broke it in pieces, and drove him from his native town.

That invention, with the improvements of Arkwright and Crompton, and the invention of the cotton gin by Whitney, who was outrageously defrauded of his rights, have changed the entire art of producing woven fabrics. Indeed, so far as the cotton industry of the world is concerned, they may be said to have created the industry, which to-day gives employment to millions, and has so immensely cheapened the product that it is used the world over.

This opposition to and unbelief in the possibility of the success of inventions has not been confined to the ignorant alone, but has been shared by many educated and even great men. When it was proposed to build a railroad in the United States, Chancellor Livingston, one of the greatest men in the State of New York, published a letter in which, as he thought, he demonstrated the utter impossibility of the proposed undertaking. His reasons were, first, that it would require a massive sub-structure of masonry the whole length of the road, and that would be so expensive that it would not pay; second, the momentum of such a moving body as a train of cars would be so great that the train could not be stopped until it got several miles past the place; and, third, no one would want to risk his life flying through the air at the rate of 12 or 15 miles an hour.

So, too, Daniel Webster expressed grave doubts as to the possibility of railroads, saying, among other things, that the frost on the rails would prevent the train from moving, or from being stopped if it did move.

When the Baltimore and Ohio Railroad was first opened from Baltimore to Ellicott City, an excursion was given to an invited company composed of prominent citizens, among whom was Mr. Seaton, editor of the Washington *Intelligencer*.

In describing the trip, which was by cars drawn by horses, on the old flat or bar rail spiked to wooden stringers, he said they were in mortal terror, lest some of the cattle feeding by the roadside should get on the track and throw them off. In winding up his long description, he said that he thought it possible that it might be of use for the carriage of goods, as on a flat, smooth surface, like the rails, a horse could haul much more than it could on an ordinary road; and, as to travel by rail, he said that he thought it possible to attain a speed of 12 miles an hour, which would be as fast as anyone would ever want to ride!

Now, when we have in the United States about 220,000 miles of railroad tracks,—an amount so great that it would take a locomotive 4½ months, travelling at the rate of 60 miles an hour and 24 hours per day, without a single stop, to traverse it,—and when on some the regular speed is 1 mile per minute, and for short runs even more, one

can hardly believe that such ideas were ever entertained, least of all by men such as those mentioned.

All this and much more is the result of invention ; for, as was well said by Senator Platt, "a railroad, from the steel rail to the top of the smoke stack, from its locomotive head-light to the signal lantern on the platform of the last car, is but an aggregation of inventions." Still, the history of the world is full of such incidents and "doubting Thomases." They stand like mile-posts along the pathway of every art and science, and serve to mark the progress of mankind in civilization.

Probably no class of men make so many unpatented inventions as civil and mechanical engineers. There is scarcely a single great mechanical structure or work of any kind, in which they do not invent or devise new means and methods for expediting the work and improving the structure ; and these works, dotting the face of the earth, are so many monuments to their inventive skill and ability.

When Murdoch invented or discovered a means for producing illuminating gas, no less a man than Sir Humphry Davy ridiculed the idea of using it for lighting purposes, and said, if it was to be used for street lighting, they would have to use the dome of St. Paul's for a gasometer. Sir Walter Scott made clever jokes about "sending light through street pipes" and "lighting London by smoke," but subsequently had his house lighted by it. Wollaston, a scientific man, said "they might as well attempt to light London with a slice from the moon." It is but a few years since the scientists of Europe demonstrated mathematically that the electric current could not be divided for incandescent lighting ; but to-day the contrary is demonstrated by millions on millions of incandescent lights, illuminating every spot where civilized man resides.

But the strangest of all things in this connection is the fact that, even in this enlightened age, there are men who still insist that inventions are injurious. It is not many years since that, in a paper published at the national capital, there was the statement that the invention of the steam engine and the sewing machine were two of the greatest curses that ever befell mankind!

It is, moreover, a matter of history that in certain sections of this enlightened land prayers were fervently offered in churches beseeching that the wickedness of the newly-invented sewing machine, which, it was supposed, would rob the sewing women of their means of obtaining a living, might become apparent, and its promoters be stricken by a conviction of their wrong-doing in making it, and thus be told by Heaven to desist from its manufacture.

As illustrating the difficulty of securing the adoption of new ideas,

I may mention a more recent instance. When the war broke out in 1861, I spent much time in the effort to induce the government to adopt breech-loading guns and metallic cartridges, but it took 3 years to secure the former, and the latter were not adopted until 1868.

In 1861 or 1862 the president of Sharpe's Rifle Co. came to Washington to secure a contract to furnish its rifle for the Berdan sharp shooters. I endeavored to convince him of the advantages which would result if it would adopt the metallic cartridge and reduce the caliber of its gun, but in vain. He said the metallic cartridge would never be adopted, and the chief of ordnance, in April, 1864, told me that the government would never adopt it. Now both have been adopted the world over.

This spirit of opposition exists to-day to a greater or less extent among the labor unions, whose members, without investigating the subject, are made to believe that labor-saving machinery deprives them of employment, or at least will lessen their wages just as the silk weavers of Lyons thought in regard to Jacquard's loom, and as the spinners of Lancashire thought in reference to Hargreaves's spinning-jenny.

This belief exists because of a want of knowledge of the facts on the part of these men, and because it has been fostered by demagogues for political purposes to secure the votes of these men. It is only a short time since a United States Senator, in a public address, asserted that the fact that so many men had been thrown out of employment during the past 2 years was due to the introduction of labor-saving inventions or machines.

It is no doubt true that, when a new invention is introduced which revolutionizes some particular art or branch of business, it at first decreases the number of persons employed in that particular line; but that is only temporary, for in a short time the result is a cheapening of the product, a greatly-increased demand for it because of this cheapening, and then necessarily an increased demand for laborers in that line, and almost universally at increased wages.

The statistics of the country show this to be true beyond the possibility of question. The records of the labor bureau show that from 1860 to 1880, the most prolific period in this country of inventions, and the most intensified in all directions of their introduction, the population increased 59.51 per cent., while in the same period the number of persons employed in all occupations—manufacturing, agriculture, domestic service, and everything—increased 109.87 per cent.; and in the decade from 1870 to 1880 the population increased 30.08 per cent., while the number of persons employed increased 39 per cent.

As the commissioner of labor says: "An analysis of these state-

ments shows that the increase of the number of those engaged in manufacturing, mechanical, and mining industries,—those in which the influence of inventions is most keenly felt,—for the period from 1860 to 1880, was 92.28 per cent., as against 59.51 per cent. increase of population." And he adds: "If statistics could be forcibly applied to show the new occupations brought into existence, I believe the result would be still more emphatic."

As shown by the investigation of a Committee of the Senate, wages have increased 61 per cent. in the United States since 1860. And, as all know, during that same period the cost to the people of nearly all manufactured articles has been decreased in as great if not a greater ratio. As with manufacturers, so with farming. As a recent writer has well said, "the use of patented machinery has so changed agriculture that there is more propriety in saying that we manufacture crops than in saying that we raise them." And still another writer says: "We use implements that cheapen the cost of production, and make the labor of harvesting like the sport of the fairy books."

According to the statements of Mr. Larimore to the foreign commission from the World's Fair visiting Dakota, he had, "by the adoption of improved machinery and methods, reduced the cost of raising wheat to $4.50 to $5.00 per acre. The cost of harvesting, the most laborious and expensive feature of farming abroad, was there reduced to half a cent a bushel; and yet, notwithstanding this extensive use of machinery, it was impossible to secure all the hands needed at from $3 to $4 per day."

While most people have the idea that inventions have mainly benefited the manufacturing industries, it is susceptible of demonstration that they have benefited our agricultural industries nearly, if not equally, as much.

In speaking of the condition of the United States, a recent English observer says:

"America has for many years enjoyed an amazing degree of prosperity, so much so indeed, that, to use the eloquent words of Edmund Burke, 'generalities, which in all other cases are apt to heighten and raise the subject, have here a tendency to sink it. Fiction lags after truth, invention is unfruitful, and imagination cold and barren.' The United States has 65,000,000 people, who spend more on dress than any other people on the face of the earth," and who, he might have added, enjoy more of the comforts of life in all directions than any other people on earth.

"Again," says he, "in spite of the wonderful development which has taken place, the possibilities, I might say the certainties, of future progress were marvellously illimitable."

REVIEW OF THE ENGINEERING PRESS

WITH A DESCRIPTIVE INDEX TO THE LEADING ARTICLES PUBLISHED CURRENTLY IN THE AMERICAN AND ENGLISH ENGINEERING AND ARCHITECTURAL JOURNALS.

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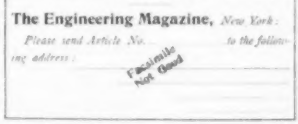
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ARCHITECTURE & BUILDING

See also "Civil Engineering" and "Domestic Engineering."

Municipal Control of Buildings.

EACH year appears to increase the legal restrictions which surround building operations in great cities. Every large city now has its building law, chiefly dealing with questions relating to safety of construction, rights of owner and builder, prevention of fires, maintenance of certain standards of building, and similar limitations of a constructive or sanitary or physical nature. But the architect is no longer satisfied with limitations such as these. It is one of the penalties we must undergo from the diffusion of architectural knowledge that it is now possible to exert public opinion on questions that once were not so much as thought of, but which are now gravely discussed and determined, not by the architect alone, but by eminent personages of no architectural knowledge at all. So far as this country is concerned, little has been done in the way of municipal control of buildings and esthetic matters, save in the regulation of heights of buildings, of which has been said of late a great deal measured by words, but little measured by facts or common sense. A further "advance" was attempted in the effort to place a bill requiring the licensing of architects upon the statute-books of the State of New York, in the winter of 1895, as though the art of architecture could be improved by legislative enactment!

In foreign countries legal restrictions concerning building in cities are much more stringent than in America, and a paper by Dr. G. B. Longstaff, of the London county council, read before the Architectural Association of London in November last, and printed in *The Builder* (November 30), affords some interesting insights into English views on this subject that may be of interest to American students of architectural ideas at this time. A few years ago, for example, some enterprising tradesmen in London conceived the idea of erecting huge wire screens upon the tops of their buildings, with legends setting forth the name and business of their proprietors. One was rash enough to project a sign against the dome of St. Paul's. A huge outcry was raised, and, as a result of the agitation, no more signs of this sort were permitted to be built, and those already up were ordered down. Perhaps this was a real artistic advance, but it certainly shows a remarkable state of public opinion that such a subject could be made a matter of general discussion.

More horrible than this, if we are to accept Dr. Longstaff's opinion, was the proposal of that national British joker, *Punch*, to erect a cistern for a "sprinkler" upon lofty steel legs on the top of the building, "for all the world like a colossal spider. But," adds the doctor, "the council crushed this new form of vermin, ere it had emerged from the egg." We have not yet reached this point in America, and, while it may indicate an advance in municipal improvement, we are not yet ready for such radical restrictions upon freedom of action. Those citizens of New York who are privileged to view the top of the Havemeyer building from the rear must recognize the unartistic effect of the various tanks, cisterns, and other mechanical contrivances gathered upon its roof. A more unshapely mass does not exist in the metropolis; yet would our constructionists, who maintain that every necessary part of the building shall be freely expressed in their construction, maintain it would have been better to have enclosed all these within a screen of wall? Truth might have been sacrificed by such a method, but certainly art would have gained by it.

A more notable instance is the building of the American Surety Company in New York. This is a twenty-one-story building on a lot about eighty-five feet square. Very wisely, and quite remarkably as an instance of the heeding of artistic effect in purely commercial structures, the design has been carried around all four sides of the building, which thus assumes the natural form

of a tower. Quite as happily, also, the roof is perfectly flat, the cisterns and tanks being kept within the line of acroteria with which the cornice is crowded. Here we have a notable case of the best artistic arrangement without the interposition of a compelling law, and resulting solely from enlightened and thorough artistic knowledge and a fine appreciation of the fitness of things. When such results can be accomplished by knowledge alone, why add laws compelling such action, which might not be possible in every case without undue hardship?

Such, certainly, would seem the more reasonable course. Nevertheless, it is evident that in this unoriginal age of architecture, which so sadly needs every encouragement to freedom, more and more restrictions are being laid upon building.

A Painter on Scenic Art.

No Englishman in recent years has given greater attention to the artistic phases of scenic art than the celebrated painter, Professor Herkomer. Not only has this gentleman published several articles on this subject in the English magazines, but he has constructed a theatre of his own, in which he has put his experimental knowledge to practical use. It is not too much to say that he has carried his researches far beyond anything American audiences are familiar with, his naturalistic effects and mechanical appliances being much superior to those employed by Sir Henry Irving, whose stage pictures are unquestionably the finest yet presented to American audiences.

An extended paper on "Scenic Effect" was read before the Architectural Association in London in December (*The Builder*, December 14) by Professor Herkomer, in which he recapitulated his theories and explained his ideas. Much of his paper was naturally concerned with the production of artistic effects on the stage itself, but the architecture of the audience-chamber received some notice. The two principal defects referred to in this particular were the present plan of the theatre, in which part of the audience is below the level of the stage and part above, and almost all at various situations and angles; and the unartistic effect of the modern proscenium arch, which is pieced out below by hangings and other movable or temporary fixtures, instead of being a true frame to the picture it encloses.

The difficulty of seating is one not to be overcome in the conditions under which the modern theatre thrives. In a house of a given size it is essential that every available spot be used by spectators, who, as the *Builder* editorially remarks in discussing this paper, would rather pay less for seeing the play in an unsatisfactory seat in a gallery than the prohibitive price that would be required were the seats limited to a single floor level, rising in a slight curve or incline from the stage. Prof. Herkomer does not appear to be familiar with the form of theatre devised by Messrs. Adler and Sullivan of Chicago, and so finely illustrated in their Auditorium and Schiller Theatre in that city. It is true that the difficulty referred to by the professor is not overcome in these American theatres, but they afford certain conveniences of plan and novelty of arrangement with which every writer on the theatre, and especially on its artistic aspects, should be familiar.

As to the relation of the proscenium to the picture on the stage, it is obvious that we cannot have every stage-picture of the same size, though it is clearly absurd, as the professor points out, to represent a room in a cottage as of the same size as a hall in a palace. But the proscenium is more than a frame to the stage picture; it is an integral part of the architecture of the interior, and much of the success of the architect's design depends on the nature of his stage-opening. It is true enough that the purpose of the proscenium is to provide an opening for the picture on the stage, but its relation to the scheme of architectural decoration cannot be ignored. The reader interested in scenic art will do well to read the whole of the professor's article for fuller particulars as to his experiment.

The Beaux Arts Society of Architects?

THE AMERICAN ARCHITECT (December

14) contains the pleasing announcement that at the annual meeting of this organization in December a form of initiation for the admission of new members was adopted. We congratulate the society on this advance, and beg to assure it of our warmest interest in this occurrence. Those of our readers who will take the trouble to refer to their copies of this magazine for June, 1894 (Vol. VII, p. 418), will find that we long since pointed this out as an omission in the programme of the society, and it is with no usual pleasure that we find our suggestion acted upon. Our informant adds that the ceremony added much to the "fun" of the occasion. We do not understand why this should be so. On their own account, and taken at their own valuation, the members of this organization are the only Consecrated and Earnest architects now doing business in America. Why, then, should admission to this solemn Order be an occasion of "fun"? That it should be a joy for the neophyte to become one of the Fold can readily be seen; that it should be a source of happiness is true enough; that it should be an occasion for general congratulation may be true also. But "fun"? Surely this is scarcely the word with which to describe so solemn a ceremony!

Our readers will recall that we ventured to make two suggestions, at different times, to the members of the Beaux Arts Society. One of these has now been acted on; we trust that our other suggestion—the making of the editor of the *Architectural Review* an honorary member—will not be further postponed.

High Buildings and Fires.

GEN. WM. SOOYSMITH contributes a paper to *Stone* for December on the dangerous character of the modern steel fireproof office-buildings. The writer does not believe in the safety of this method of construction, and argues that stone columns should be substituted for the present steel framework, which he regards as radically unsafe. He claims also that the terra cotta fireproofing is quite inadequate to resist the destructive force of a severe fire.

It is a matter to be regretted that so distinguished an engineer, who has taken much active part in the erection of a number of steel buildings, though his work has been largely that of making their foundations, should have seen fit to raise his voice in protest against the most carefully built structures of modern times. It is true, as he remarks, that there have been fires in buildings called fireproof, the latest notable instance being the Manhattan Savings Bank in New York, which recently experienced almost total destruction from a fire communicated to it from an adjoining structure. The burning of this building was the signal for every opponent of the large commercial building to cry aloud with horror: "I told you so."

That the bank building in question did burn down, that the fire was a bad one, and that the building was nominally fireproof are facts not to be disputed; but it is further true that no one would have offered this structure as a type of the best and latest fireproof construction. It was not a new building, and the destructiveness of the fire was largely due to defective construction.

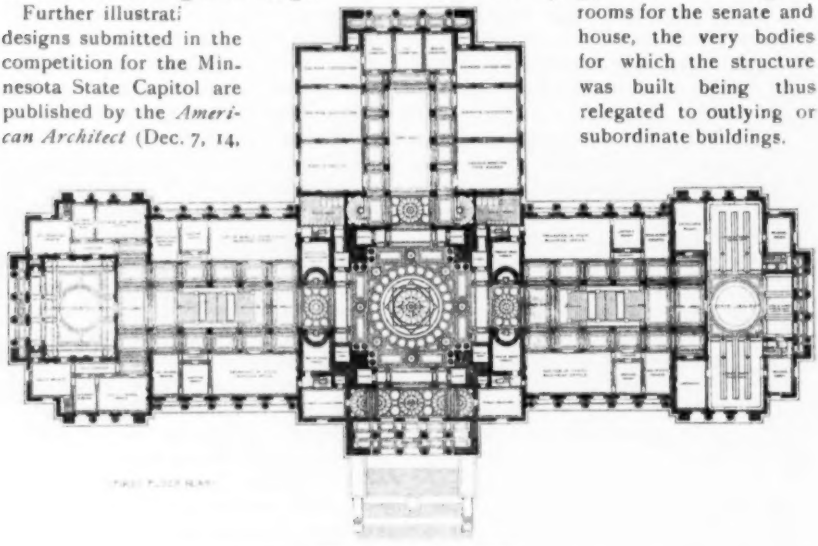
Illustrations of the Month.

THE competition of the month—these architectural scrambles for work are now so numerous that scarcely a month passes that does not witness the conclusion of one or more of them—was that of the library for the State Historical Society at Madison, Wis., of which the *Inland Architect* for December publishes three designs, commented on below. In mercantile drawings the same journal publishes a part of the fine Equitable Building in Denver, with small photographs of the interiors,—none of them new, but pleasant and agreeable reminders of one of the most notable office-buildings in the country. *Architecture and Building* (Dec. 14) publishes a fine photograph of the Constable Building, New York,—a stately and imposing structure that may rightly be classed among the most successful great buildings of the metropolis. An indistinct reproduction of a water-color drawing in *The Builder* (Nov. 30), of Moorgate Court, London, illustrates

the new premises of the Ocean Accident and Guarantee Corporation,—a picturesque structure whose conception is quite as distinct from the idea of an American commercial building as its design.

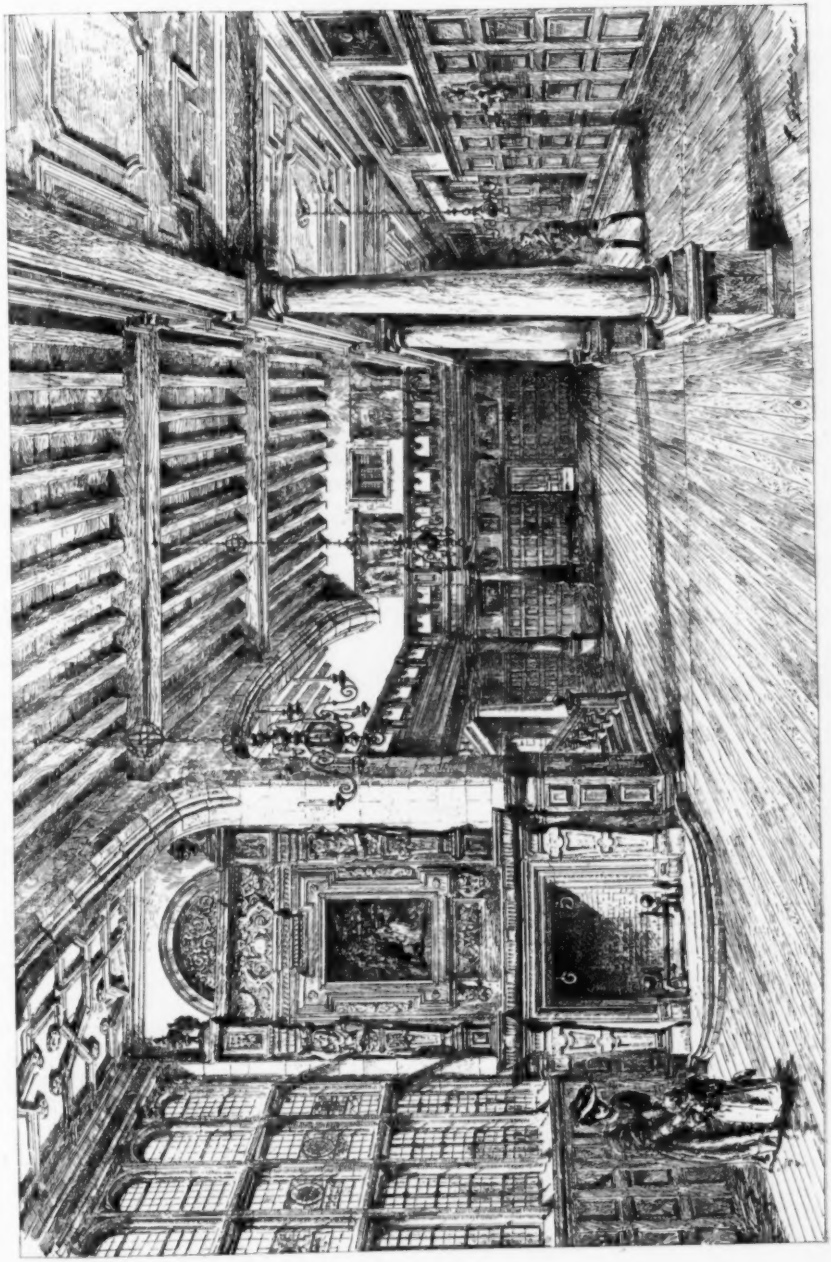
SECOND PRIZE DESIGN FOR MINNESOTA STATE HOUSE.

Further illustrati designs submitted in the competition for the Minnesota State Capitol are published by the *American Architect* (Dec. 7, 14, and 28). Of these that by Mr. E. Flagg is a grandiose composition with a striking exterior and a badly-conceived plan. It consists of a vast rectangle with an open court in the center, containing a circu base for a dome connected with the surrounding structure by stair-wells. Short narrow passages connect the central block with two outlying portions containing the rooms for the senate and house, the very bodies for which the structure was built being thus relegated to outlying or subordinate buildings.



MINNESOTA STATE HOUSE.

Architecture and Building (Dec. 28) prints two photographs of houses built at Madison, N. J., by Boring & Tilton. The same paper publishes a large photograph of the



ASHORNE HILL HOUSE: INTERIOR OF HALL.

house for Mr. J. J. Astor in New York by the late R. M. Hunt (Dec. 7). It is accompanied with a critical estimate of Hunt's art by Mr. Barr Ferree. An illustration of the fine Roman Catholic Church of St. Augustine in Brooklyn, by Parfitt Brothers, in the same publication (Dec. 14), should be mentioned as the most notable church of the month.

In the country houses *The Builder* (Dec. 7) publishes three pretty cottages by Mr. T. W. Cutler, together with some interesting interiors, and two groups of stables. A peculiarity of that city is the making of "places" or terraces, shut off from the more public parts of the town by gates and other enclosures. The result is a semi-secluded park, whose houses on either side have a certain ornamental and suburban air which they could not have in unenclosed streets. The illustrations referred to show how ornamental such a system of city-planning may be as well as how charming are some of the designs made for the enclosing gateways by several of the architects of St. Louis.

MODEL APARTMENT HOUSES.

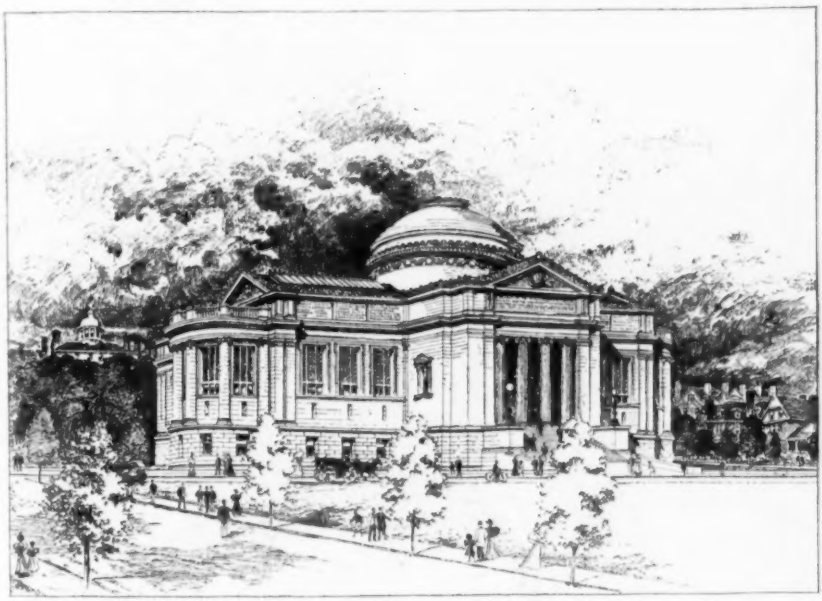
In city houses also might be included the block of apartment houses in Union, N. J. (*Architecture and Building*, Dec. 21), reproduced herewith, though there would appear no reason for tenement or apartment houses in any town of New Jersey. A group of sketches of cloisters in southern France and Italy by Mr. J. C. Halden is given in the *American Architect* (Dec. 14).

An exceedingly interesting group of municipal adornments in St. Louis is shown in photographs of four gateways, in the *American Architect* (Dec. 7 and 21).

The *British Architect* (Dec. 13) offers as a holiday supplement a series of eighteen pen-and-ink sketches by the well-known English pen-draughtsman, Mr. T. Raffles Davison. Under the general head of "A West Country Ramble," this accomplished artist presents a series of beautiful views of English churches and old houses, with several new country mansions to give it, as it were, a modern flavor. We have sketches in Malvern, Cheltenham, Hereford, Hanley Castle Church, Malvern Priory Church, Worcester Cathedral, and

Tewkesbury Abbey; of older houses we have a view of Savern End, "Bad Batsford," by Ernest George & Pete; "Perry Croft," by C. T. A. Vosey; and "Englewood, Stroud," by P. Morley, with a couple of old houses and a sheet of carved detail. The drawings are admirably done, and will be cordially welcomed by Mr. Davison's admirers.

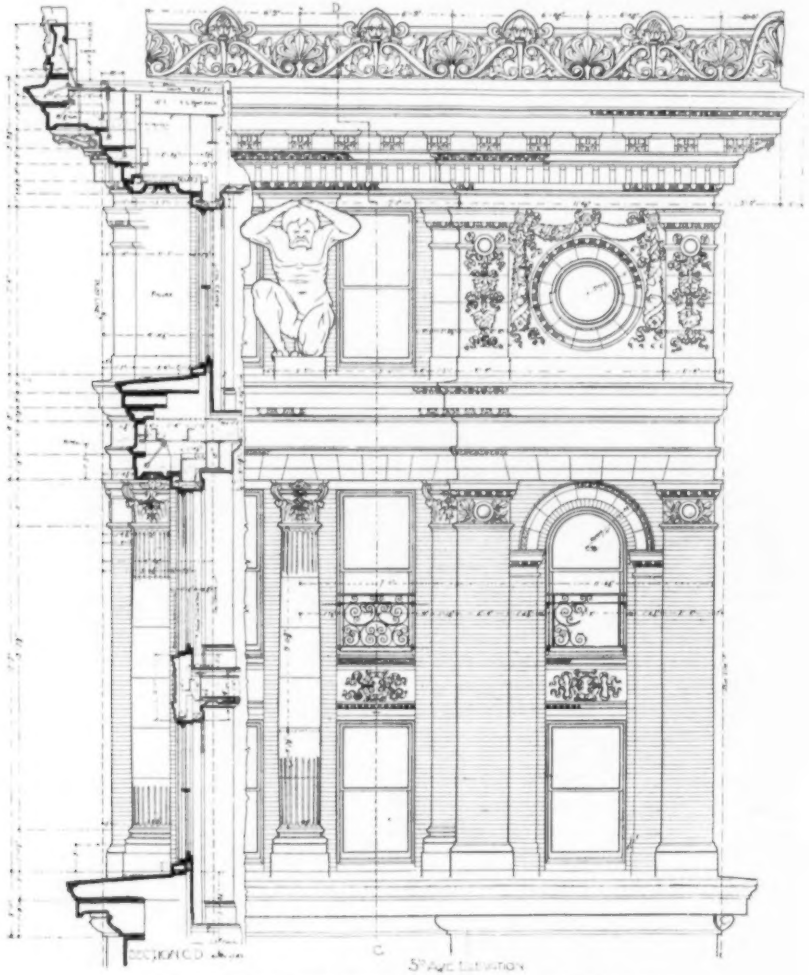
THE INLAND ARCHITECT (Dec.) does good service in publishing three of the pre-



LIBRARY BUILDING, HIST. SOC., MADISON, WIS.

miated designs submitted in the competition for the Wisconsin Historical Society's library, the selection, which rested between two unpublished drawings, not having been made at the date of publication of that periodical. It also prints in full Professor Ware's report as expert. It is a carefully drawn document, and shows great justice of judgment, with that clear perception that has long since made its author famous. Of the ten designs submitted four were provided with the low domes that came into favor with the Fine Arts Palace and the Agricultural Hall at the Chicago World's Fair, to which buildings they bore a more or less marked resemblance. This is, we believe, the first instance where so large a portion of the designs illustrated this style of building. It is to be hoped that the fashion set in it will not become popular. The design of Messrs. Peabody and Stearns, illustrated herewith, is a long rectangle with a vestibuled pavilion in the centre and two stack-rooms extending behind. It is doubtless intended as a Greek building, though the dome that surmounts the central hall is Greek only in name. It is a monumental design,—the most so of those published,—but suffers from this very character. Why, in this epoch of elevators, should the visitors to the library be forced to climb an external flight of steps a full story in height? It is true, there are elevators within, entered from unimportant doors in the basement; but surely, if they were needed, it would have been more logical to have placed them close to the main en-

trance. And why a high external flight of steps? This architectural device originated in the sunny south, under clear skies and in dry lands. Is it possible that it never rains in Madison? Certainly there



DETAILS, TERRA COTTA WORK, PARK BUILDING, PITTSBURG, PA.

are few things more unpleasant to do than to climb or descend a high flight of marble steps in the rain. The design by Mr. C. S. Frost is a cruciform building, with a mimic dome and portico for the entrance, neither of which appears to be properly related to the rather severe design of the rest of the building. The design submitted by H. C. Koch & Co. is a large rectangular structure, treated in a stately manner, with slightly projecting pavilions on the corners and a connecting colonnade on the main front. The entrance is on a level with the street, and the use of external steps is very successfully avoided. Errors in planning prevented this design from obtaining a winning chance in the competition, to which its architectural form entitled it.

THE BRICKBUILDER (Dec.) publishes among its admirably-chosen illustrations of recent brick and terra-cotta buildings a couple of sheets of detail of the terra-cotta work on the new Park Building in Pittsburg, Pa., by Mr. G. B. Post. The parts illustrated show the three upper stories and three intermediate ones, but, as no information is given as to the total height of the building, it would appear difficult to estimate the resultant value of this detail in the actual structure. The upper section shows a two-story feature, with columns and pilasters, with an attic story above, in which are atlantes supporting the main cornice. The design is worked out with a good deal of care. The cornice below the attic story is plainly treated, and projects but slightly beyond the wall line. It has not, therefore, the effect of deliberately cutting off the attic, which is so frequently the case in designs of this nature. Unfortunately, however, the cornice below the pilastered section has a much greater projection, though it is not so deep, and what is gained in one place is lost in the other. The atlantes *motif* was employed by this architect in his well-known Havemeyer Building in New York, though not with the best effect. There they are standing figures, and above their cornice are two additional stories, which have a most unhappy added-on effect. In the Pittsburg building the atlantes are stooping figures, the attic story being a low one, and the cornice above them is surmounted by a crest, without other stories. Judging from the published drawings, the design is a considerable advance on the New York design, though it may be questioned if a good deal of the elaborate detailing is not lost at the height at which it is placed. This is a very common failing of many of our high buildings, and is quite natural in a work that, like their design, is confined to study on paper. It is obviously impossible to effect a remedy after the building has actually been erected, but so many instances of errors of judgment are now on public view that it is strange the architects are not more alive to this circumstance. The Park Building, however, does not appear to be worse off in this respect than many others. As a matter of fact, also the Havemeyer Building is nearly free from this error.

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*3007. Architectural Sculpture in America. Ill. Russell Sturgis (A critical review of the purely decorative sculpture employed by leading American architects). Eng Mag-Feb. 2800 w.

*3077. Architectural Education. Dr. Rowand Anderson, and Editorial (Extract from presidential address to the members of the Edinburgh Architectural Assn.). Builder-Dec. 7. 5000 w.

*3078. The Planning of Board Schools. Charles Henry Wyatt (A paper read before the Manchester Soc. of Arch. Views based on practical acquaintance with school life). Arch, Lond-Dec. 6. 4500 w.

3081. Commissioner Russell's Report on the New York State Capitol (An abstract of the report which was adopted, and plans ordered prepared in accordance with the recommendations). Arch & Build-Dec. 14. 1300 w.

*3156. The Fire-Trap Modern "Sky-

We supply copies of these articles. See Introductory.

Scraper." William Sooy Smith (A thorough discussion of the inadequacy of so-called fireproofing, as applied to modern tall buildings, and a proposed plan for rendering them really fire-proof. Gives an account of tests of the crushing strength of stone columns of a stated construction, and believes they may be practically and advantageously substituted for steel in tall structures). Stone-Dec. 3400 w.

3160. The Advantages Claimed for Brick and Steel Factory Buildings (Describes the style of construction called "composite," and states its advantages. Examples, recently erected in Providence, R. I., by the Berlin Iron Bridge Company, meet with great favor). Ir Age-Dec. 19. 1500 w.

*3173. The New Building of the Boston Public Library. T. R. Sullivan (A very interesting and finely illustrated description). Scribner's Mag-Jan. 3800 w.

†3188. The Study of Architectural History at Columbia College. William R. Ware (The writer claims that exceptional advantages are given. Beside instruction by text books and lectures, separate exercises are given in Historical Research, Historical Drawing, and Historical Designing(. Sch of Mines Quar-Nov. 4400 w.

*3212. Iron and Steel for Building Structures (The use of iron and steel in building is exemplified by brief and general illustrated descriptions of numerous tall buildings in American cities). Ir & Coal Tr Rev-Dec. 13. 2300 w.

*3213. Scenic Art. Prof. Herkomer (An address before the Arch. Assn., London, considering the construction of the auditorium of theatres; realism on the stage; and the lighting of the stage). Arch, Lond-Dec. 13. 9000 w.

*3214. Mural Painting by the Aid of Soluble Silicates and Metallic Oxides (A paper by Mrs. Lea Merritt and Prof. Roberts-Austen, read before the Soc. of Arts. Results of experiments by the writers, in the hope of promoting the advance of decorative art in relation to the church). Arch, Lond-Dec. 13. Serial. 1st part. 5200 w.

3219. The Montclair, N. J., Bank Building. Ill. (Plans and details of a banking and office building). Eng Rec-Dec. 21. 1500 w.

3225. A Churchyard of Palaces. Ill. L. von Krockow (An interesting description of architectural features of some towns in North Germany). Am Arch-Dec. 21. 2300 w.

3270.—$1.50. Hollow Tile Floors, Past and Present. Fr. von Emperger (The development traced, with accounts of tests made, and suggestions of requirements according to load and span submitted by the author for discussion). Tr Am Soc Civ Eng-Dec. 3300 w.

*3304. The Origin of the Hellenic Ionic Volute. Max Ohnefalsch-Richter (Abstract of a paper read before the Roy. Inst. of Brit. Arch. Concludes that the Ionic volute was derived from the Egyptian lotus-flower design, with reasons). Arch, Lond-Dec. 20. 800 w.

*3305. An Historical Review of Architecture. Willian Ransom (A popular lecture given at the Victoria Institute). Arch, Lond-Dec. 20. Serial. 1st part. 900 w.

*3307. An Australian Opinion on Tiles and Slate. James Nangle (From a paper on "Roof Coverings," recently read before the Eng. Assn. of N. So. Wales, with table showing absorption of water by different varieties of roofing tiles and slates used in Sydney). Builder-Dec. 21. 1000 w.

3355. Iron Construction and Erection of Tremont Temple. C. H. Blackall (Detailed illustrated description). Eng Rec-Dec. 28. 3200 w.

†3401. The Sculptured Columns of the Temple of Diana at Ephesus. Ill. Alex. S. Murray (Read at a meeting of the Royal Inst and followed by discussion. Architectural points to be determined in the reconstruction of the temple). Jour of the Roy Inst of Brit Arch-Nov 21. 9000 w.

†3402. Some Recent Discoveries at Nemi, in the Roman Campagna. Ill. J. Tavenor Perry (An account of what has already been accomplished in the exploration of this interesting region). Jour of Roy Inst of Brit Arch-Dec. 5. 1500 w.

†3403. The Brotherhood of Architects: An Essay. Paul Waterhouse (Originally delivered as a sessional paper before the Sheffield Society of Architects and Surveyors). Jour of Roy Inst of Brit Arch-Dec. 5. 5200 w.

3412. Myths, Superstitions, Romance and Humor of Architecture and Building Fred. T. Hodgson (An interesting account of the traditions connected with ancient buildings) Arch & Building-Jan 4. Serial. 1st part. 2000 w.

3413. Sculptured Decorations by J. Massey Rhind. Neil Macdonald (Illustrated description of sculpture decorations for buildings by the artist named—principally the work done for the American Surety Building). Arch & Build-Jan. 4. 800 w.

3414. Arch and Vault Tests of the Austrian Society of Engineers and Architects (Report of the Committee, with illustrations). Arch & Build-Jan. 4. 1400 w.

†3512. The Modern Office Building. Barr Ferree (A lecture delivered before the Franklin Inst., Nov. 15, 1895. An able summary review with references, in foot notes, to the recent literature of the subject from which more extended accounts of the points brought under discussion may be obtained; these references not being quoted as authorities, but as forming a key to more extended study). Jour Fr Inst-Jan. Serial. 1st part. 5000 w.

3522. A Notable Church Moving Operation. Ill. (From *Carpentry and Building*. The moving of a large stone church with a high tower, all of the most massive construction, in Chicago, Ill.) Ir Age-Jan. 9. 1200 w.

3533. Tests of the Strength of a New Fireproof Floor (Floor construction invented by G. Knoche. The advantages are cheapness and the very small space taken up by the floors, walls and partitions). Eng News-Dec. 12. 600 w.

We supply copies of these articles. See introductory.

CIVIL ENGINEERING

For additional Civil Engineering, see "Railroading" and "Municipal Engineering."

The Simplon Tunnel.

THIS tunnel will be 12¼ miles long, making it much the longest tunnel in the world. The contracts have been made and the plans prepared, and the work will be finished in about 5½ years. The tunnel will be double, having large sections for traffic, and a smaller one, connected with it at intervals, for the purpose of ventilation. London *Engineering* (Dec. 6) gives an excellent account of the organization and plans, and full description, with drawings illustrating the method of construction. It says:

"There is now every prospect of a tunnel being bored through the Alps at Simplon to connect the Switzerland railway terminus and Brique with the Italian terminus at Domo d'Ossola. There have been many schemes within the past twenty-seven years, but difficulties, principally financial, between the two countries have involved delays and alterations. However, a convention between Italy and Switzerland has at last been signed, and the work will now be proceeded with.

"We have recently described the several Alpine tunnels in detail, but it may be interesting here to give one or two figures which indicate the relative importance of the several tunnels as compared with the Simplon project:

	Simplon.	St. Gothard.	Mont Cenis.	Arlberg.
Length of tunnel.....miles.	12.26	9.3	7.98	6.36
North or east portal above sea level..ft.	2254	3639	3766	4566
South or west portal above sea level.....ft.	2080	3757	4164	3908
Highest level....ft.	2314	3788	4248	4300
Maximum grade in tunnel per 1000,..	7	5.82	22	15
Maximum thickn'ss of mount'n above tunnel.....ft	7005	5598	5428	2362
Possible maximum temperature of rock..deg. Fahr.	104	85	85	65

"The tunnel will pass through the mountains in practically a straight line S. E.-N. W.

"From the northern portal there is to be a rise of 175 ft., equal to 2 per 1,000,—a minimum for drainage to the Rhone,—and the decline to the southern portal is on a grade equal to 7 per 1,000. This is a much lower gradient than in the Mont Cenis and Arlberg tunnels, although rather more than in the St. Gothard.

The tunnel, beginning at the Swiss end, runs through three miles of gypsum and six miles of limestone, schists, and gneiss, the remaining part running through mica schist and gneiss. "The temperature between kilometers 6.6 and 17.1 will be greater than the maximum of 85 deg. at St. Gothard, and it is anticipated here that it may possibly reach 104 deg., assuming here also the increase to be 1 deg. for each 144 ft. of superincumbent earth. There will be two parallel tunnels for single lines, 55 ft. 9 in. apart.

"In driving the tunnel there will first be small headings. These headings will be about 10 ft. high and 12½ ft. wide, and, as in Fig. 11, will be lined where necessary. At intervals of 220 yards there will be cross galleries of similar section connecting the two tunnels. Of the two headings, only one will, in the meantime, be opened out to the full section, but the other will be completed when the traffic requires a double line through the mountain.

"Brandt's rotary hydraulic drilling machines will be used, although for a short distance at either end hand-drilling may be resorted to temporarily. Where gneiss has to be penetrated, the pressure will be 1,500 lbs. to the square inch; otherwise it will be 1,000 lbs. There will be six or eight machines at each heading. A feature of this drill is the form of the cutting tool. It is about 3 in. in diameter, and there are three cutting points, like claws. It is slightly rotary, and is kept up to its work by hydraulic pressure. The drill is hollowed as indicated by the dotted lines.

Fig.7. For strong vertical pressure.

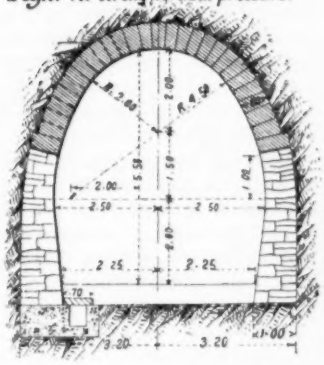
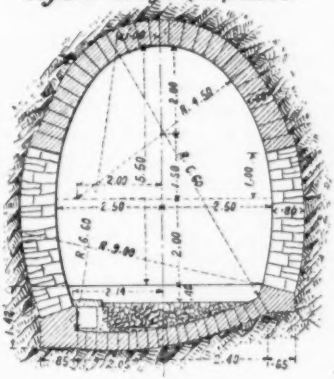


Fig.8. For strong lateral pressure.



SECTIONS OF TUNNEL IN UNSAFE GROUND.

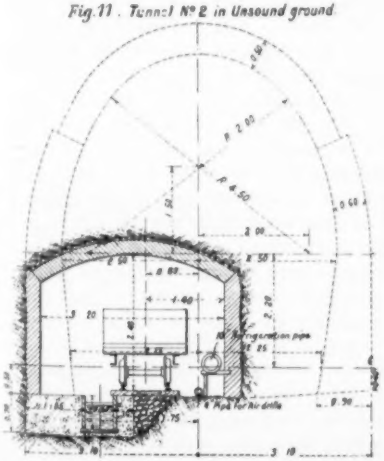
and through this waste water from the motors is discharged against the working face, thus keeping the cutting edge cool and at the same time washing away the *débris*. Twelve machines, it is anticipated, will require 4 gallons of water per second. In hard rock 12 to 15 holes 2¾ in. in diameter and about 49 in. deep will be needed; in schist, 8 to 10 holes 55 in. deep.

"Tests were made at Winterhur with Antigorio gneiss, the hardest rock in the Simplon, to determine the possible rate of progress. In the first experiment a hole was drilled 3 ft. 3 in. in 23 minutes, but one of the drills proved too soft. In the second experiment the time occupied in driving 4 ft. was 13½ minutes, including all delays in lengthening the borer. There was greater caution taken before the experts than would be in practice, so that the speed might have been greater.

"The total contract price is, for outside work, £280,000; for first single tunnel with parallel heading, £1,900,000; for completing this heading into second tunnel, £600,000; so that the total for the two single-line tunnels complete is £2,780,000. As to the adequacy of these estimates of expenditure, the experts report at some length."

A fine of £200 for each day required over the stipulated time will be paid by the contractors, and they will receive a premium of £200 per day during such time as may intervene between completion of the work and the time set therefor.

Fig.11. Tunnel N° 2 in Unsound ground.



Rules for Concrete Work.

THE following is taken from a paper in the *Journal* of the Association of Engineering Societies, having the title "Concrete Construction on the Illinois and Mississippi Canal," by Mr. J. W. Woermann, and reprinted in *The Engineering Record* (Jan. 11). These rules were compiled by Capt. W. L. Marshall.

"(*a*) All massive concrete-work should be divided into sections by vertical planes at right angles to the longest dimensions or on approximately radial lines, if curved

to determine in advance the planes of weakness along which cracks due to contraction in setting or to changes in temperature shall take place.

"(*b*) These sections must be built in successive horizontal layers, as thin as practicable, each layer being well rammed in place before the previously-deposited layer shall have had time to partially set. This rule calls for continuous work, from base to coping, day and night, if necessary, and the work must be rubbed smooth on the top surface and completed without cessation of operations.

"(*c*) There must be no definite plane or surface of demarcation between the facing and the concrete backing, but the facing and the backing must be deposited in the same horizontal layers and rammed in place at the same time. As far as practicable, the matrix or mortar of the concrete should be homogeneous from face to back of wall. It is permissible to increase somewhat the proportion of cement in the mortar near the face, in order to give greater strength, but the cement must be the same as in the concrete mass. No mixture of cement and lime, or of cements of different qualities, should be made. Diverse cement concretes should be connected by dovetails.

"(*d*) No plastering or finishing of surfaces, other than sifting sand and cement on the surfaces, if too wet, and rubbing hard with a float, is allowable, or any practice that develops planes or surfaces of weakness other than the vertical planes already noted.

"(*e*) The concrete or mortar shall be mixed with no more water than they will carry without quaking in ramming; they shall be deposited immediately after mixing; and shall be kept well shaded from the sun and supplied with water, at least at the surface, until well set."

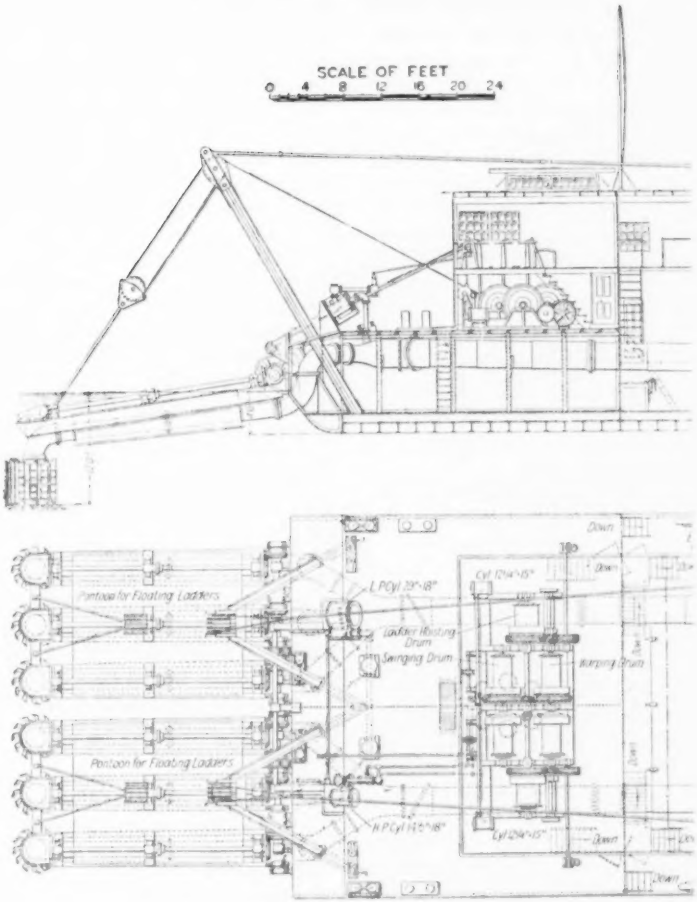
An Enormous Suction Dredge.

ANY one not acquainted with the peculiarly vacillating character of the Mississippi river channel does not appreciate the difficulties our government engineers have to contend with, not only in making a navigable channel, but also in maintaining it. As some of these dredgings involve the removal of a large quantity of sand and mud in a short time, it was found necessary to design a dredge commensurate to the task. *The Engineering Record* (Dec. 14) thus describes the first of this type now under construction:

"A great hydraulic dredge that will be larger, more powerful, and have a greater capacity for sand and mud excavation than any single machine previously built, has been designed by Lindon W. Bates, C. E., of Chicago, and is being completed on the Mississippi river at Cairo by the Maryland Steel Company, of Sparrows Point, Md., who are the general contractors with the United States government to build the dredge for working on bars and deepening and maintaining the channel of the Mississippi river. The general data of the machine are: length, breath, and depth of the steel hull, 172′×40′×7′10″; boilers, 3,000 horse power; pumping capacity, 6,000,000 gallons per hour; estimated cost, $200,000.

"In order to make a 40-foot cut through a typical bar in 24 hours, and thus provide an initial channel for the river to enlarge by its own erosion, it was assumed necessary to remove 25,000 cubic yards of material; and it was therefore specified that, to secure abundant capacity, the machine should be able to dredge at least 1,600 cubic yards per hour. It is predicted that, under favorable conditions, it will be able to dredge 3,000 cubic yards an hour, and it is expected that the official trials will develop a capacity sufficient to secure a considerable bonus offered.

"The operation of the dredge is essentially as follows: six hollow cylinders 5 feet in diameter are placed in a row 35 feet long across in front of the bow of the boat, and, when revolved about their vertical axes, cut into the bottom and loosen the soil, which, when suspended in the water, is pumped up through six 30-inch pipes, one through the center of each cutting cylinder. These pipes are connected, in sets of three, to the 33-inch suction pipes of two separate and independent and powerful centrifugal pumps that deliver the mud and water through two lines of 33-inch steel pipes with flexible joints that



U. S. SUCTION DREDGE. SECTIONS OF FORE END.

are supported on floats and convey the soil several thousand feet away, if necessary, and discharge it at the necessary height for deposition on waste dumping grounds or for filling in swamps and building up dams, levees, etc. The dredge is moved longitudinally, laterally, and radially when at work by the operation of spuds, and is equipped with a complete power plant and apparatus for auxiliary service.

"The mechanical cutter system is capable of working to adjustable depth up to 26 feet; an excavating apparatus for severing the dredged material to bring it within the field of the suction of the pipes is so arranged that the dredge may make a maximum straightaway cut 5 feet deep and 36 feet wide on the bottom in any fixed position of the cutters.

"The maximum swinging cut will measure below water level 26′×5′5″×235′, bringing within the reach of the dredge without forward movement 1,400 cubic yards. The minimum width of cut with all cutters in bank is 36 feet; with three cutters in bank, 18 feet. The dredge machinery is mounted upon a double-bottomed steel hull, built

of ⅜-inch plates, provided with ballast tanks and compartments, and the double bottom provides a 2 foot space divided transversely into separate cells; beside which the bulkheads are made air-tight."

The article contains full description of all parts, including directing and propulsion rigging, pumps, engines, hull, boiler-water filter, pontoon pipe, etc. Should the operation of this dredge prove satisfactory, a dozen more may be built for similar government work.

The Report of the Nicaragua Canal Commission.

"AN alleged abstract of the report of the Nicaragua Canal Commission was exclusively published by the New York 'Herald' of Nov. 25," according to the *Engineering News* (Nov. 28). "The commissioners find that new and exhaustive surveys will be necessary before sufficient data will be at hand to make any conclusive estimate and report upon final location, and they give their own conclusions and estimates with this caution. The report practically condemns the present location from Greytown to Brito; or at least suggests very many marked departures from the plan proposed and increases the cost from the canal company's estimate of $69,893,660 to a 'provisional' estimate of $133,472,893. To obtain the necessary data for the finding of a final project, the Commission says that 18 months would be required covering two dry seasons and that this investigation would cost about $250,000.

"Very elaborate tables are submitted comparing the Commission's estimates of quantities and unit prices with those of the company as corrected to 1895. A comparative recapitulation of the cost is thus given:"

	Company's estimate.	Board's estimate.
Eastern division	$31,299,844	$51,306,295
Lake and river division	5,922,705	26,234,343
Western division	20,549,091	28,186,773
Lights and buoys	273,000	500,000
Management and engineering	.....	4,000,000
Hospital service	.....	1,000,000
Totals	$58,244,717	$111,227,411
Contingencies 20 %	11,648,943	22,255,812
Grand totals	$69,893,660	$133,472,893

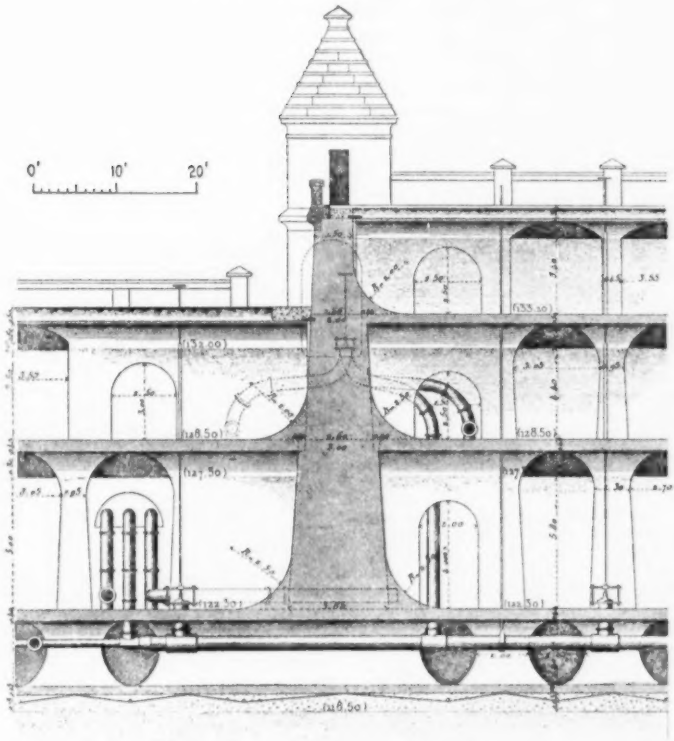
Masonry Reservoir of Montmartre, Paris.

IN order to prevent leakage and possible disaster by flooding, the reservoirs of Paris have been constructed with more than ordinary care, especially with regard to devices for preventing the leakage of water into the previous underlying gypsum formation. The *Engineering News* (Dec. 26) describes the construction of the reservoirs at Villejuif and at Montmartre, Paris. The latter is of considerable interest, and we here give some extracts from the description:

"The Montmartre reservoir is located on the top of the 'Butte' at the side of the church of the Sacred Heart and covers an area of 24,800 sq. ft. Its capacity is 2,900,000 gallons. It consists of five totally independent basins, each provided with its own system of pipes and valves so that it may be emptied for inspection or repairs. The basins are in two groups, separated only by a partition wall and supported by a double bottom foundation. The first group, located at the side adjoining the church, comprises three superposed basins. The lowest has a depth of 16.4 ft. available for storage; the second has a depth of 11.5 ft.; and the topmost has a depth of 9.2 ft., or a total available depth of 37.1 ft. The second group comprises two superposed basins; the lower has a storage depth of 16.4 ft., and the upper has a depth of 11.5 ft. corresponding to the middle basin of the first group.

"The general foundation of the work was a concrete bottom 30 in. thick, resting on a bed of fine yellow sand about 16.4 ft. thick, overlying the marls above the gypsum.

"The bottom of concrete has been built in such a manner that the water permeating the masonry cannot pass entirely through it, and the surrounding earth cannot be injured by leakage from the reservoir. For this purpose, the 30 in. total thickness of the bottom has been divided into two portions. The lower part, having a thickness of 20 in., has its upper surface formed into a series of shallow channels, covered with an impervious layer of Portland cement mortar. Four-inch open joint tile drains are placed in the lowest part of



Longitudinal Section.

each channel, and lead to an accessible gallery, forming a main collector, which connects with a public sewer. Any water which may permeate the upper part of the floor is guided by the impervious coating to the drains, and thus to the sewer, and has no opportunity of reaching the sand foundations.

"The pillars serve as supports to the columns of the stories above. The latter decrease in cross section as they ascend, and are built of gritstone masonry, except the brick columns of the top basin. They rest directly on the cement covering of the corresponding floors. Supported on the brick columns are the groined arches of double course brickwork, forming the roof. These are placed around the walls by cylindrical arches, and at the angles by cloistered arches resting on buttress piers of the same thickness as the columns, and pierced with passages from 6.5 to 8.2 ft. wide. The columns and buttress walls are covered with a coat of cement mortar, like the exterior walls and floor, while the arches supporting the floors remain uncoated, so as to allow any water which may pass through the coating of a basin to pass into a lower basin or into the galleries of the double bottom.

"Cracks due to expansion or contraction occur more often in the bottom than in the exterior walls. When a crack has been located, the coating of cement mortar is picked away for 2 to 2½ ins. on each side of it, the fissure is scraped with an iron blade, and is then well washed. A slip of wood or cardboard 0.04 to 0.08 in. thick is placed in the crack, and a coating of Vassey cement 0.4 in. thick is laid on each side of it. When the slip is withdrawn, it leaves an opening of

uniform width. The cement is thoroughly dried by means of small charcoal braziers, and the empty space is then filled with pure unvulcanized india rubber cemented to the coating by a solution of india rubber in benzine. Finally the opening is closed with cement mortar, and surfaced off. This last coat generally cracks, but the water that pen trates it is stopped by the india rubber, which also permits a slight expansion or contraction of the masonry. This method of repairing cracks is due to Chief Engineer Couche, who has introduced it quite generally in the Parisian water-works service."

THE ENGINEERING INDEX—1896.

Current Leading Articles on Civil Engineering in the American, English and British Colonial Engineering Journals—See Introductory.

Bridges.

*3080. Rapid Bridge Building (An account of the rebuilding of the Cutter bridge which passed over the river Ouse at Ely in about eleven hours actual working time). Ill Car & Build–Dec. 6. 400 w.

*3091. New Railway Bridge Over the Weichsel at Dirschau. (Description of German bridges, built side by side, as illustrated by *Le Génie Civil*). Eng, Lond–Dec. 6. 2400 w.

*3099. Reconstruction of the Cutter Bridge, Ely; Great Eastern Railway. Ill (A descriptive article telling how an old cast iron bridge was replaced by a wrought iron structure without interfering with the railway traffic.) Engng–Dec. 6. 3000 w.

3175. The Cornhouse Bridge, Berne, Switzerland. Ill. Elmer L. Corthell (Description of location, method of securing plans, details of plan adopted, which is of the steel arch and pier type, and an examination into the possibility of American competition in such work). Eng News–Dec. 19. 2400 w.

*3207. The Evolution of the Iron Arch. (A short sketch of the development of the arch in construction). Eng, Lond–Dec. 13. 2400 w.

†3235. Permissible Stress in Girders. F. J. E. S. (A theoretical discussion). Ind Engng–Nov. 16. 2200 w.

3293. Compressed Air at Seventy-seven Pounds Per Square Inch (Experiments by Mr. Hersent, a French engineer, demonstrating the fact that men may work safely in caissons at a depth of 164 ft., or about 5.4 atmospheres per square inch pressure). R R Gaz–Dec. 27. 500 w.

3423. A New Steel Arch Bridge Over the Niagara Gorge. Ill. Orrin E. Dunlap (Bridge over the Niagara, replacing a suspension bridge. It will be the longest span steel arch bridge ever built). Eng News–Jan. 2. 1000 w.

*3480. Strengthening Lendal Bridge, York. Ill. (Method employed in strengthening a cast iron arch bridge to accommodate heavier traffic). Eng, Lond–Dec 27. 1300 w.

Canals, Rivers and Harbors.

*3006. The Free-Port of Copenhagen. P. Vedel (Describing the engineering work that has been done to preserve Copenhagen's position as the distributing center of the Baltic). Eng Mag–Feb. 2500 w.

3087. An Enormous Suction Dredge (A dredge designed for government work on the Mississippi river channel, having the enormous capacity of 3000 cubic yards per hour. It is thought to be the largest yet built). Eng Rec–Dec. 14. 1800 w.

*3174. Water-ways from the Ocean to the Lakes. Ill. Thomas Curtis Clarke (Interesting historical account of the Erie Canal, cost, transportation rates, etc., with comments on proposed improvements; also brief review of the history of ship canals, with considerations relating to the Nicaragua Canal). Scribner's Mag–Jan. 4000 w.

†3184. The Missouri River. Ill. George S. Morison (One of a course of lectures delivered to the students of the School of Mines, Columbia College, under the auspices of the Department of Civil Engineering. The effects of silt-transportation as shown by map of points along the river taken at intervals). Sch of Mines Quar–Nov. 5000 w.

3233.—§1. The Advantages of the Nicaragua Route. J. W. Miller (The advantages of the route of the canal as at present located, considering the Lake of Nicaragua, its advantages to an isthmian canal, and its approaches, natural and artificial). An Am Acad–Jan. 1700 w.

3357. Paint as a Protection for Iron (Discussion at a meeting of the Engineers' Club at Phila. Practical experiences are given). Ry Rev–Dec. 28. 2400 w.

3238. Condition of Work on Chicago Drainage Canal (A graphical and tabular statement of the progress of the work, by the president of the board of trustees. The figures given are instructive and to the point). Ry Rev–Dec. 21. 800 w.

*3444. The North Sea and Baltic Canal. Max am Ende (Paper read before the Inst. of Civ. Engs. An interesting description of the work, giving many items of cost, dimensions, etc.). Ind & Ir–Dec. 27. 3000 w.

*3473. The Villa Mantle for Protecting River Banks. Ill. (The device consists of perforated clay brick, strung on zinc or other wire, and sunk on the bank to be protected. It has been used in Italy and France). Engng–Dec. 27. 300 w.

3532. Methods of Work on the Chicago Main Drainage Channel (A summary of previous articles on the canal. The purpose of the enterprise was not only to prevent the sewage

We supply copies of these articles. See introductory.

laden waters of Chicago River from polluting the lake water supply, but also to be a ship canal, connecting the Great Lakes with the Mississippi River). Eng News–Dec. 12. 4500 w.

3546. The Riker's Island Cribwork. Peter Elbert Nostrand (A well illustrated description of a cribwork to prevent washing at Riker's Island, where the city refuse is dumped. The crib was built on a mud bottom, and had to be repeatedly repaired. Improved methods are suggested). Eng News–Jan. 9. 1200 w.

Hydraulics.

3088. Payson Park Reservoir, Cambridge, Mass. (Description of the construction of a billion and a half gallon storage reservoir at Hobbs' Brook, with connecting pipe lines. The construction of the central concrete core for the embankment, is an interesting feature). Eng Rec–Dec. 14. 2700 w.

†3170. Water Power of Caratunk Falls, Kennebec River, Maine. Samuel McElroy (Paper read at meeting of A. S. M. E. Describes and discusses the catchment basin, rainfall and power investment, and makes comparisons between this water power and that obtainable on other New England rivers, concluding with a discussion of site advantages, etc.) Trans Am Soc Mech Eng–Dec. 3300 w.

3269.—$1.50. Notes on High Masonry Dams. John D. Van Buren, with discussion and Correspondence (A theoretical treatment of the conditions of safety, the forces acting upon the dam, the design of a proper section, effect of ice pressure, etc., with sections of several dams and a lengthy and interesting discussion by eminent engineers). Tr Am Soc of Civ Eng–Dec. 8000 w.

3322. Precautions in the Construction of Large Masonry Reservoirs. Ill. M. Dutoit (Translated from the "*Annales des Ponts et Chaussees.*" The method and reason for the construction of double bottomed reservoirs.) Eng News–Dec. 26. 4000 w.

*3331. Stream Measurements and Water Power in Virginia and West Virginia. D. C. Humphreys (The results of work for the U. S. Geological Survey). Jour of Assn of Eng Soc–Nov. 2400 w.

Miscellany.

*3098. The Simplon Tunnel (A well illustrated description of a proposed tunnel through the Alps at Simplon, connecting Italian and Swiss railways. The contract has been let, and the principal engineering features of the work are described). Engng–Dec. 6. Serial. 1st part. 3700 w.

†3111. Railroads and Canals. Correspondence of John Stevens during 1811-1812 (Copies of some old documents, pamphlets, and letters showing the condition of canal and railway transportation at that time). Steven's Ind–July. Serial. 1st part. 6200 w.

3126. Portland Cement. Eugene A. Smith (Paper read before the Alabama Industrial and Scientific Society. Brief description of the raw materials used with analyses, and the chemical composition of a good Portland cement). Tradesman–Dec. 15. 1200 w.

3162. Portland Cement. Spencer B. Newberry (Report of the annual meeting of the Assn. of German Portland Cement Mfrs. The subjects reported on were uniform testing, specifications, the influence of magnesia, the effect of sea water, and some tests on hardening of cement). Sci Am Sup–Dec. 21. 3500 w.

3164. The Making of a Tunnel—The Waterloo and City Railway. From *The Graphic*, London (Illustrated description. The tunnel runs through clay, under the river, a total distance of a mile and a half; the excavation work is done under air pressure to keep out the river water, the iron casting following it up). Sci Am Sup–Dec. 21. 1200 w.

†3236. The "Terrameter." G. D. (Description of a rapid distance measurer, resembling a transit. Results are accurate to a foot, within 300-ft. of distance). Ind Engng–Nov. 16. 1400.

3271.—$1.50. Moving Two 36-in. Water Mains Without Shutting Off the Water. E. C. Moore, with Discussion, and Correspondence (Illustrated description with itemized cost). Tr Am Soc Civ Eng–Dec. 3300 w.

3272.—$1.50. Tests of Fire-Proof Flooring Material. George Hill (An exhaustive and valuable series of tests fully described and illustrated). Trans Am Soc Civ Eng–Dec. 6000 w.

3274. Water in Concrete. A. S. Cooper (A letter to the editor giving the results of tests tending to show that mixing mortar "wet" gives the best results ultimately though it will not do so on short time tests). Eng & Con–Dec. 20. 600 w.

3292. Plant of the Rocky Hill Stone Storage Company (A model plant in New Jersey, for the crushing of trap rock for ballast, etc. A complete description, illustrated by cut of plant, locomotive and cars is given). R R Gaz–Dec. 27. 2000 w.

*3309. The Temperly Transporter. Ill. (The transporter consists of an I beam supporting a travelling carriage. It is portable and easily adapted to any condition). Ind & Ir–Dec. 20. 1300 w.

*3332. Progress of the American Portland Cement Industry. Robert W. Leslie (Read before the Boston Society of Civil Engineers. Notes upon the general properties of cement and the later developments in manufacture in the United States). Jour of Assn of Eng Soc–Nov. 7500 w.

*3482. The Blackwall Tunnel (The description is well illustrated, and the manner of overcoming the unusual difficulties encountered is fully treated). Eng, Lond–Dec. 27. 5000 w.

3542. The Use of a Gin-Pole for Erecting a Water Tower at Montezuma, Ia. Ill. (An economical device which is worthy of notice. This framed pole was 4 × 4 ft. in section, and afterwards carried the supply pipe from the tank, and was boarded up and packed to act as a frost box). Eng News–Jan. 9. 200 w.

DOMESTIC ENGINEERING

Domestic Water Filtering.

INDIAN ENGINEERING (Nov. 9) gives useful hints upon this subject. After some general remarks on the removal of microbes by filtering, as effected by Koch and others, and on the admitted impossibility of the complete removal of disease germs by filtering alone, at the same time conceding the sanitary value of filtration, it declares that it still regards the perfection of the system by further treatment in houses as a necessity, illustrating this point by a description of the Indian "*chatty*" filter.

"The market has been flooded many years with all sorts and manners of domestic filters. One filter that has not, up to date, found a place in the advertisements of manufacturers is the 'chatty filter' of the country. This was regarded, but a few years back, as a rough, but nevertheless valuable, adjunct to water purity. The media consisted of sand, vegetable charcoal, and pebbles. It cannot be said, that, when carefully arranged and compacted, this filter did not fulfil the function of securing a grade of chemical purity; but, in actual practice, it must have occupied a most unsatisfactory place in guarding the family circle from the inroads of disease. The management of the filter was generally delegated to the *bheestie*. It was sufficient for the house-wife to know that sand was produced, and that, say, every month fresh material was placed in the *chatties*. It was a matter of no moment whence that sand came. It is needless to say that the usual place was the bed of a neighboring *nullah*, where Ram Bux and his friends assembled in the very early morning to discuss local politics. Under such circumstances, the household energy was directed towards cleansing the sand by passing water through it, and securing a filtrate the character of which can be better imagined than described. But, since the Suez Canal was opened, most have pinned their faith on more ornamental filters designed by manufacturers of stoneware. These are usually supported by glowing statements from chemists as to the grade of purity secured. Some, not content with stating that the water was purified by bringing about a chemical change, insisted that they had overridden nature's law as to nothing going to waste by declaring that the filters required no attention whatever; they were self-cleansing! It is hardly necessary to say that the observations of any one having the slightest knowledge of hygienic conditions soon showed that all these advertisements of filters made to sell were but too often, not the saving agent, but the causes of diseases in European households. Filters, to be self-cleansing, necessarily required no care, and were delegated to the *khansmah's* intelligent supervision. Nothing was more common than to find a household trusting to a filter provided with a sponge, as the first medium through which the water was required to pass,—a gelatinous mass of inorganic filth and a breeding place for microbes. Matters such as these have, during the last two years, become of sufficient notoriety to throw doubt upon the reckless statements of manufacturers and of chemists either too greatly wedded to their own science to believe in bacteriology, or possessed of sufficiently flexible consciences to give certificates that, like the oracles of old, read in the sense the reader may feel inclined to adopt. Sims Woodhead, on behalf of the British Medical Association, carried out a very careful series of experiments, and came to the decision that, of all the various filters in the market, none but those primarily intended to act as microbe-catchers were of any real efficacy in the prevention of diseases."

Even the Berkfelde and the Chamberland-Pasteur filters (porous clay filters), which absolutely eliminate the germs when first put into use and produce a strictly sterile filtrate, will, after three days' use, no longer do so. It has been shown in the case of the Berkfelde filter that "cholera bacilli effect an entrance by

growing through the pores of the filter." This shows the necessity of sterilizing the filter at intervals not exceeding three days, which is quickly and conveniently done by placing the porous cylinder in boiling water and keeping it there until every part of it has attained the temperature of the water and ten minutes longer. The sterilization of any filtering material can, in like manner, be effected by filtering boiling water through it for such time as will bring it to, and hold it for a short time at, the temperature of the water.

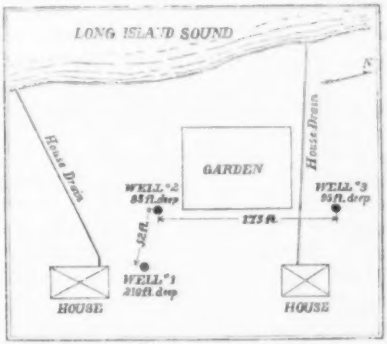
An Interesting Well Experience.

AN abstract of an article by H. De B. Parsons, in *The Stevens Indicator* (Oct.), emphasizes the caution that should be observed in locating wells for domestic water-supply.

The well in question was located near Rye, Westchester county, N. Y. An unsuccessful attempt to obtain sufficient water at the point marked 1 on the accompanying map having failed, another, at the point marked 2, succeeded in obtaining a yield of about a gallon per minute, with which, though a scanty yield, the proprietor was forced to be content. The quality of the water was then examined. The well was equipped with a small hand-pump, and water was pumped about ten minutes each day for four days, when a sample was analyzed by Mr. Alfred L. Beebe. The result of this analysis was the condemnation of the sample on account of the presence of nitrites, the high percentage of albuminoid ammonia, and nitrogen in nitrates and organic and volatile matter, indicating the infiltration of surface water of bad quality, apparently contaminated with sewage.

The well marked No. 3 had been previously bored, and had been used continuously for five years, and, as no sickness had been caused thereby, and as, from the nature of the ground, it did not seem possible that sewage contamination could be present, even from distant sources, it was decided to make an analysis from well No. 3.

The analyses of the waters of these wells showed that the water was of the same general character, and that it probably came from a common source. There was a marked difference, however, in the quantity of nitrogen present, and of free and albuminoid ammonias. The reduction in the quantity of total solids by evaporation was probably due to the longer period of use, which had thoroughly cleared the well. It, therefore, seemed that the apparent contamination of well No. 2 was entirely due to the effects of dynamite exploded in well No. 1 (which had been done in the hope of increasing its yield), and for domestic purposes it was just as good as that obtained from well No. 3. A slight improvement between the first and a



second analysis of the water from well No. 2 was probably due to continued pumping, which sucked into it from well No. 1 certain quantities of nitrogen, showing in the increase of the nitrates as well as in the increased amount of free ammonia.

It will probably be many months before the apparent contamination will be exhausted, and it thus appears that, under special conditions, even rock-bored wells may have their waters contaminated by infiltration. In this case, had the water been used without the precaution of a chemical analysis, the results might have been injurious to the users.

Drying Rooms.

NO first class mansion is now erected without a provision of a room wherein laundry-drying can be effected in wet weather when out-of-door drying is impossible. That the majority of domestic drying-rooms are not constructed in ac-

cordance with scientific principles is evident from an acquaintance with their construction, and comparison of it with that of such drying-rooms as would result from the application of the principles set forth in a paper on the subject by J. L. Henry, Jr., in *Heating and Ventilation* for December, an abstract of which is herewith given.

For each increase of 27 degrees in the temperature of the air its drying capacity is doubled; in other words, the capacity of the drying-room can be doubled by increasing the temperature of the room 27 degrees. For ordinary laundry work a temperature of about 130 degrees has been found most satisfactory. When wet clothes are first placed in the room, the temperature falls from 20 to 30 degrees, but gradually moves up again as the goods become dry. The successful construction of a drying-room depends upon plenty of heat and a bountiful supply of fresh, clean air. In no system of heating are the benefits of direct radiant heat more manifest than in the drying-room; for this reason the heating surface is most effective when so placed that the direct rays of heat from it will strike on at least one side of the article to be dried. It is even of more importance that the air-supply should be so arranged that, in addition to coming into direct contact with the heating surface, it will also penetrate and completely surround every article to be dried. A rapidly-moving current of air—say 250 or 500 feet per minute, according to the articles to be dried—is most effective.

In drying-rooms of ordinary steam laundries, as generally constructed, either no provision or one totally inadequate is made for the entrance of fresh air; this, combined with the improper arrangement of entrance and exit openings, when any are provided, results in great waste of heat and fuel, and in a prolongation of time for drying that would not be required with a properly-constructed drying-room. Many firms manufacturing laundry machinery expose their ignorance of this subject by illustrating in their catalogues drying-rooms with an exit at the top of the room only, with no provision for a supply of fresh air. An exit at the top of the room is allowable for just one object,—that is, to establish a draught in the vent chimney. After this has got well under way, the ceiling exit should be closed, and the floor exit used. With the air entering at the floor, and with the exit at the ceiling, the air will move in a straight line from the inlet to the outlet and become only partly saturated, the result being a loss of heat and fuel. With the inlet and exit at the floor, the air is brought in contact with the articles to be dried in both the upward and the downward current; and, being confined longer, becomes more fully saturated. From the above it will be seen that the two points to be looked after in the construction of a drying room are: (1) to have sufficient surface to heat the air to a high temperature, and to have it so arranged that the radiant heat will be most effective,—that is, so that it will strike against all of the articles to be dried, if possible; (2) to have the inlet and main exit at the floor, of ample size, and so arranged that the air will not become thoroughly heated upon entering, but will penetrate and surround the goods to be dried.

Domestic Boiler Explosions.

As to explosions of heating boilers, Mr. R. C. Carpenter, in *Heating and Ventilation* (Nov. 15), says that, considering the total number of heating boilers in use in the United States, the number of domestic boiler explosions is very small; "so that, if we suppose no improvement in construction over the ordinary methods, the risk which any person would run is very slight; and it seems quite probable that, if one were to use a heating boiler as safe as the average boiler, the chances would be that, if he did not die until killed from this cause, he would live to be ten thousand years old. And, estimating from the total number of boilers in use for heating, as compared with the number of explosions of such boilers, the chances are that one per year in ten thousand would explode."

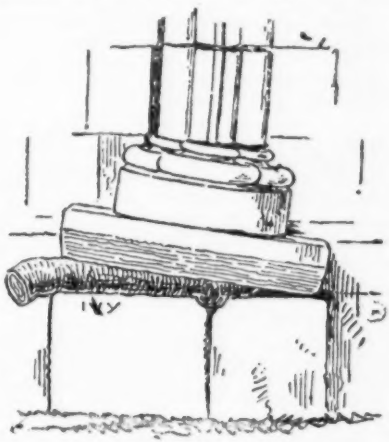
Notwithstanding their rarity, householders should understand that explosions are

possible, and that they usually result from inexcusable neglect, such as allowing water to freeze in pipes, closing valves in mains when steam is up, or faults in safety valves that proper care would discover and remove. Mr. Carpenter names several such explosions that have occurred in the United States, and expresses the view that "no boiler is entirely free from explosion when it is badly managed; but, on the other hand, it also appears that the sectional boilers, or boilers in which the water occurs in small quantities, are subject to injuries which are comparatively slight and generally easily repaired. So far as the writer can find from a study of all the explosions recorded in the United States, the water-tube boilers, or those with small masses of water, are singularly exempt from disastrous explosion. They are, however, quite likely to have some part broken away, in which case the pressure on the boiler is relieved quickly enough to avert a serious explosion. The worst accidents which usually happen to sectional boilers are those due to the burning out of a tube or some easily replaceable part. This results ordinarily in a very severe leak, which, however, can be repaired."

Damage to Buildings by Vegetable Growths.

THE practice of training creeping plants over masonry is increasing. While a very pretty and pleasing effect can in this way be produced, there are some doubts whether the effects in inhabited buildings are not unsanitary, and there is certainty that injury to structures often results from the practice. The dampness retained by a thick vegetable growth is surely a condition favorable to the decay of timber, and —at least in a frame building—it might be one unfavorable to the health of the occupants. The possible effect upon masonry is well illustrated by a cut in *The Gardeners' Chronicle*, herewith reproduced. This represents the condition of masonry in the ancient Abbey of Cwm Hir, in Wales.

"The sketch illustrates the destructive work of ivy. An ivy stem 3 in. in diameter has bodily raised the wall pier from its setting, and at the same time pushed it forward out of the wall for 2½ in. In a second instance an ivy stem 2¼ in. in diameter has pushed through a vertical joint between two of the basal stones, and moved the wall to that extent. In so doing the ivy has split into pieces three of the horizontal stones above. Another illustration of the power of vegetation to



A Remarkable Ivy Growth.

effect the destruction of buildings is noted at Cliveden, where a branch of a fig tree growing in a forcing-house has pushed itself between the courses of the brick wall at the front of the house, and is heaving the upper courses of brick out of the level. This branch is laden with figs and well leaved out at the present time."

DOMESTIC ENGINEERING says it has remained for the state board of health of Michigan, that pioneer in sanitary work, to take a distinctly forward step in the education of the people concerning the distribution of contagious and communicable diseases. The law of the state, passed last year, requires "that there shall be taught in every year in every public school in Michigan the principal modes by which each of the dangerous communicable diseases are spread and the best methods for restriction and prevention of each such disease." The state board annually sends the necessary printed forms.

THE ENGINEERING INDEX—1896.

Current Leading Articles on Domestic Engineering in the American, English and British Colonial Engineering Journals—See Introductory.

Heating and Ventilation.

*3079. Ventilation and Warming. W. T. Sugg (General consideration of the subject, with special reference to the work of warming and ventilating the Houses of Parliament). Arch. Lond–Dec. 6. 4400 w.

3089. Heating and Ventilating the Adams School, Duluth, Minn. (Full description of the installment, with plans. The building having been recently enlarged, a remodelling of the heating and ventilating plant became necessary). Eng Rec–Dec. 14. 1000 w.

3189. Heating and Ventilation of the Montauk Theater (Illustrated detailed description. The ventilation apparatus is designed for cooling the building in summer, by the use of ice). Heat & Ven–Dec. 15. 1500 w.

3190. Steam Heating. Ill. (An essay copied from the catalogue of a well-known firm of heating engineers. It gives directions for estimating the heating surface required in radiators, and general instructions for piping). Heat & Ven–Dec. 15. 1400 w.

3191. Combination Systems of Heating. E. C. Moses (Gives the advantages obtainable and discusses circumstances which render the use of such combinations desirable). Heat & Ven–Dec. 15. 1200 w.

3192 Forced Blast System of Heating and Ventilation. R. C. Carpenter (A very elaborate article on an important subject, by an able writer. It discusses, and gives in tabulated form, data upon volume of air discharged at various pressures; area in sq. inches for each 1000 cu. ft. space; number of small pipes which provide an area equivalent to one large pipe of similar cross section; velocity and quantity of air delivered in pipes of different diameters, each 100 ft. long, with an air-pressure equal to one half inch of water column; capacities, revolutions per minute, and horse-power required). Heat & Ven–Dec. 15. 2400 w.

3193. Drying Rooms. Ill. J. L. Bixby, Jr. (Describes practically the essentials of drying rooms, for different purposes, and illustrates different constructions by diagrams). Heat & Ven–Dec. 15. 2200 w.

3221. An Original System of Hot Water Heating (Detailed illustrated description of a plant wherein the owner insisted that the radiation should conform essentially to the simple pipe coil system used in greenhouse work). Eng Rec–Dec. 21. 800 w.

*3265. An Entirely New System of Heating (A combination of steam and hot-water systems is described, with plans of the building in which it was installed. The advantages claimed are perfect regulation of heat and ventilation, with minimum attention. Plans of the apparatus showing details are also furnished). Dom Engng –Dec. 2500 w.

*3266. Gas Used as Fuel. O. B. Server (The policy of gas companies in cheapening the cost of production at the expense of calorific value, is criticized in this able article, as tending to retard the use of gas as fuel. Notwithstanding this, its increasing use is predicted and the subject is dealt with in a way calculated to enlighten consumers of gas for heating purposes. A new rule given for computing flow of gas through pipes, will be of interest to plumbers). Dom Engng–Dec. 1800 w.

3324. Comparative Tests of Steam-Heating Radiators (Describes and illustrates an important series of experiments upon a comparatively little investigated subject. Describes both method and apparatus and gives tabulated results). Eng News–Dec. 26. 1600 w.

3356. Ventilation of an Auburn, N. Y., School (Detailed illustrated description of an interesting plant in which indirect radiation only is employed). Eng Rec–Dec. 28. 1100 w.

Landscape Gardening.

3013. School-Grounds. (An editorial reply to a correspondent regarding the educating effects of beautifying school-grounds). Gar & For–Dec. 11. 1200 w.

3381. Village Streets and Country Roads. W. J. Beal (Suggestions tending to make the highways attractive, especially in regard to the planting of trees). Gar & For–Jan. 1. 1100 w.

Plumbing and Gas Fitting.

*3263. Proper Plumbing. Ill. George F. Hammond (An excellent article, in which an unusual amount of technical knowledge of the art of sanitary plumbing is displayed, considering that the author is an architect by profession, and not a plumber). Dom Engng–Dec. 2000 w.

*3264. American Plumbing in Bath Rooms and Kitchens. Dent Yates (Photogravure illustrations and description of typical work in high-class plumbing). Dom Engng–Dec. 450 w.

*3359. Laying House Drains. (Treating of trench, fall, joints, clearing shafts, testing, etc.). Ill Car & Build–Dec. 20. 1600 w.

Miscellany.

†3041. Domestic Filtration of Water. (A caution against so called self cleansing filters, and precautions needed in all water filtering on a small scale for domestic supply). Ind Engng–Nov. 9. 1300 w.

†3516. An Interesting Well Experience. Ill. H. de B. Parsons (The dangers of water contamination in wells sunk near residences, are well exemplified in this instructive account. The description is illustrated by a diagram showing relative positions of house, drains, wells, etc.). Stevens In–Oct. 1000 w.

ELECTRICITY

Articles relating to special applications of electricity are occasionally indexed in the departments of Mechanical Engineering, Mining and Metallurgy, Railroading, and Domestic Engineering.

Direct vs. Alternating Currents.

ADMITTING all that is claimed for the efficiency of the alternating current as compared with that of the direct current, there yet remains the practical question of its practical adaptation to various uses.

Mr. William Baxter, in *The Electrical Engineer* (Dec. 11), began the discussion of this question, and the first part of his paper was certainly an able argument in support of the proposition that "the direct-current system would be more desirable, even if the alternating system were just as well suited to commercial requirements, which is not the case." Mr. Baxter makes the following remarks with reference to the present status of the alternating current and the multiphase motor.

"The only extensive application of the alternating current at the present time is for incandescent lighting. A few arc lights are also operated by it, but for this purpose it is far inferior to the direct current. Any one desiring to install an arc-lighting plant would not take the alternating system into consideration for a moment. Arc lamps of this type are only used where they are so far apart or so few in number as not to justify the expense of a separate circuit.

"For motor services it may be justly said that at the present time the alternating current is of no great practical value.

"The multiphase motor, when considered from a purely theoretical standpoint, should be equal in every respect to the shunt-wound constant-potential motor of the direct-current type. It will start under a heavy load, as the rotating field exerts a torque which increases as the velocity of the armature is reduced, and is at its maximum when the armature is at a standstill. The action of these motors, if considered without any reference to external objects, is the same as that of the ordinary direct-current machine. In the former the lines of force, or the magnetic polarity, rotate around the field, and the armature chases around after them until it catches up, and then they continue rotating together. In the direct-current machine the lines of force remain stationary in the field, and by the action of the commutator they tend to rotate backward in the armature, thus setting the latter in motion in the forward direction. In both cases these lines of force remain stationary in one part of the machine, and rotate through the iron in the other.

"Although, from a purely theoretical standpoint, there is nothing to prevent the rotary field motor from doing the same kind of work as the shunt-wound constant-potential motor, the fact that it has not come into use is an indication that there is some practical obstacle in the way. That this obstacle is of no small importance may be assumed from the fact that it is about eight years since the first of these machines was made, and still they are not in use, except in a few isolated cases."

The author next considers the reasons for the halt in the practical and commercial advance of the alternating current. It is admitted that theoretically it is adapted to driving constant-speed motors; but the largest field for motors is at the present time, and probably will be for many years to come, that of electric railways. For this class of work, and other work where the speed is not and cannot be constant, the alternating current cannot be used. It is pointed out that electric lighting is becoming a small interest as compared with the other branches of electrical industry, of which the supply of motors is the chief. In this view it is regarded as "folly to discard the direct current . . . . without an attempt to develop its possibilities, and to push forward a system that we know is not suited to our wants and cannot be utilized at all except with the assistance of the discarded direct current." This view seems entirely sensible, and it is entitled to consideration as a protest from a practical electrical engineer, not deficient in theoretical knowledge, but not allowing purely

theoretical considerations to weigh unduly against practical experience.

"We know that one of the principal objections to the alternating current is the increased difficulty of transmission, and yet we transmit energy by this system, and at the receiving end convert it into a direct current, so that we may be able to make use of it. Would it not be a wiser policy to rectify the current before transmission, and thus save, either in cost of construction, wire, or in higher efficiency of transmission? If it would be wise to go that far, would it not be still wiser to go one step further, and replace the alternator with a direct-current generator, and thus save the extra loss in transformation as well as in transmission? Obviously the correct answer to these questions is that, if the direct current can be successfully used at as high an electromotive force as the alternating, it would be the best one adapted to our requirements."

As to the respective costs of the two systems, "the direct current is the cheaper for all line construction," the cost for both copper and insulation being smaller. An alternating generator dispensing with commutators can be made for less cost than a direct-current generator. "But an alternator by itself is not a complete machine; it must have an exciter, the cost of which would be greater perhaps than that of the commutator of a direct-current generator of equal capacity. The alternator can be made self-exciting, but it would require a commutator, and its cost then would be about the same as that of a machine with a separate exciter."

The respective costs of the two systems, therefore, are not so materially different as to have much influence upon choice between them; but Mr. Baxter maintains that for either light or power the cost for installing the alternating system is the greater. He admits that the latter can be cheapened by discarding the step-up transformers, but not enough to place the two systems on equal footing as to cost. He also admits the possibility, and even the probability, that encumbrances that now embarrass the alternating system may yet be found unnecessary, though he thinks step-down transformers must be used for lighting, their avoidance in buildings supplied with current for lighting being possible through the use of larger step-down transformers in substations. "In such an arrangement the primary would go to the transformers in substations, and a secondary of, say, one hundred and ten volts could be derived for commercial purposes."

Now, as the costs of the two systems do not vary sufficiently to establish the supremacy of the direct current with an equal number of transformations, the author admits that this supremacy can be established only by demonstrating the practicability of using with it a higher electro-motive force. He believes this can be done with safety, and the first part of his paper terminates with this assertion. In the second part of the paper (*Electrical Engineer*, Dec. 18), he considers methods whereby this result can be practically achieved, and makes, in substance, the following propositions: (1) the limit of electro-motive force that can be used in either system is the insulation; (2) the pulsating electro-motive force is more trying to the insulation than the steady force of the direct current; (3) if an alternating current of a given electro-motive force can be insulated, a direct current of higher electro-motive force can be retained by the same insulation; (4) as the maximum E. M. F. of the alternating current is about forty per cent. higher than the effective E. M. F., the same insulation that will hold an alternating current with an effective E. M. F. of ten thousand volts would hold a direct current of fourteen thousand volts.

As to sparking of commutators, he says: "There is no difficulty whatever, in my judgment, in constructing a constant potential generator for fifteen or twenty thousand volts that will not spark on the commutator. All that is required is to so proportion the parts that the difference of potential between the commutator sections at the points where the brushes bear will be so low as to be incapable of making a spark. It may be said that machines made for such high electromotive force, unless of very large capacity, would require very

fine wire for the shunt coils. But, in answer to this, it may be said that it is not necessary to use shunt coils. The same results can be obtained in other ways, which admit of the use of large wire."

If it should be found impracticable to construct generators of fifteen or twenty thousand volts, the same electromotive force in the line can be obtained by the use of a number of generators having a less E. M. F. and coupled in series. The smaller machines would cost more than the large one, but Mr. Baxter holds that the total cost for a given capacity in a direct-current plant would not be greater on this account, as the same amount of copper would transmit 40 per cent. more energy with the direct current system.

The advantage claimed for the alternating system—that its "transformers are immovable masses of metal"—is only true in the case of lighting. Rotating transformers, nearly the same in design and cost as those used for direct current, must be used for power.

Commutators are now very durable parts of generators. Mr. Baxter says there are a great number of railway generators, the commutators of which (at the rate of wear under which they have worked for three years) would last thirty years. These facts certainly make a strong argument in favor of the direct current, and they will remain weighty until some further decided advance in the alternating-current system shall have been made.

The Calculagraph in Telephone Service.

SOME of the difficulties in adjusting payments for telephone service, although familiar enough to experts in the art of telephony, are not known to the general public, and an account of them in *Western Electrician* (Dec. 21) is of general interest. It needs no argument to prove that a customer who occupies materially more time at the instrument than another should pay more for the service. The time of use varies very much,—say from forty-five seconds to ten minutes. How to adjust tolls to the different times of service at telephone exchanges may seem a simple problem, but it has not been found to be such by the telephone companies. The following is an abstract of this interesting article:

An idea of the trouble that was encountered can be gained from the experience of one eastern exchange, where a determined effort was made to devise a scheme by which the time occupied in conversation would be an important factor in the cost of the service. When the new rule was introduced, the chief operator discovered that during the busy parts of the day

CALCULAGRAPH. FIG. 1

operators were in the habit of making half-a-dozen connections before recording any of them. An inspection of the cards showed in some cases that one operator would make six to ten connections at exactly the same time,—according to the records in the company's office upon which it was necessary to compute the bills of subscribers. This, of course, was an impossibility, but it seemed equally impossible to correct the practice. In one case this was explained by the fact that the clock in the operating-room was located in an inconvenient position, and most of the young ladies were obliged to turn about and look at the clock each time they received a call, if they were to comply with the requirements of the company. Taking advantage of this experience, another exchange, also in an eastern city, purchased a large number of stop-watches for its operators, but this only partially overcame

the difficulty. The main objection to the scheme was the absence of some accurate and reliable method of recording the actual time of conversation, so that it could be demonstrated beyond question, not only that the service was given, but that it was furnished at a certain time. To those who have had experience in long distance service or in exchanges centrally located, from which many lines extend out to neighboring towns and villages, and where

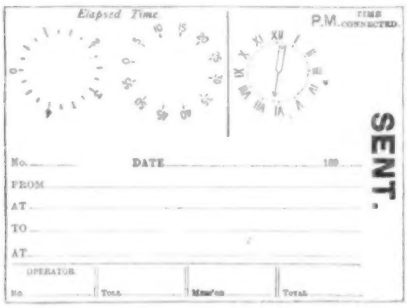


FIG. 2.

the business interests and social life of these numerous communities are so interwoven as to be practically a unit, the im-

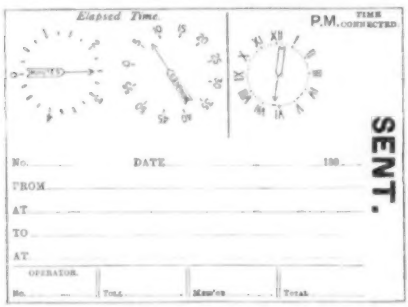


FIG. 3.

portance of this problem will be at once apparent.

About two years ago it was proposed to introduce the calculagraph into this service, and arrangements were made to conduct extensive experiments in a New York exchange. Several instruments were placed in actual service, and during the last year they have been relied upon absolutely, not only in "long-distance" service, but in the "toll" department of the local service. In the accompanying cuts, Fig. 1 shows the appearance of a single instrument completed and ready for service (as used by the American Telephone and Telegraph Co., New York). The calculagraph is a combination of a clock and recording apparatus, by which mechanical calculations and printed records of the net results are made. Tickets are used upon which the several records required are stamped Specimen records are shown in Figs. 2 and

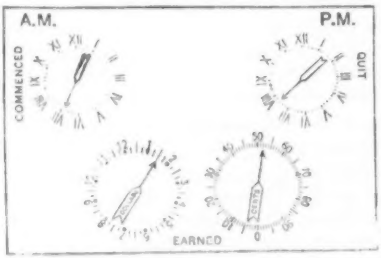


FIG. 4.

3, these cuts being reproductions of tickets used by the Central Union Telephone company; and in Figs. 5 and 6 two additional forms are given, by which it will be seen that calculations of money earned at any standard rate per unit of time can be

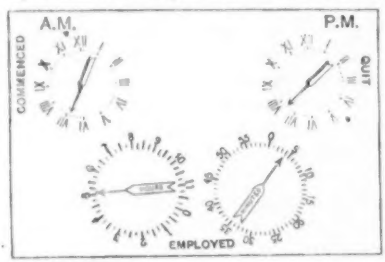


FIG. 5.

produced as readily as the record of the time occupied in a telephone conversation. This, it will be readily understood, makes the instrument applicable to many fields, including messenger service, billiard and pool rooms, livery, bicycle, and boating companies, as well as in factories and shops employing many operatives and clerks.

It is admitted by the large exchanges that thus far the instrument has met all the requirements of service. It can be

used by operators without special training, as the method of operation is very simple. At the beginning of a message the ticket is inserted in the slot at the front of the instrument against the guide, and is shoved to the right until it fits in the corner. The right-hand lever is then pushed backward and forward; this records the time of day, and also makes an impression of the two dials at the left, but not of the pointers. At the end of the message the ticket is again inserted in the slot in the same position as before, and the left-hand lever is pulled forward, thus printing in the center of the two left-hand dials the two pointers, indicating the figures which represent the exact length of time that has elapsed since the first impression.

Thus these instruments record the time of day a connection is made for a conversation; the time which elapses between the first "ring-up" from the subscriber or the local exchange and the time when the person wanted at the distant city comes to the receiver and communication is completed between the two persons who wish to talk; the time which elapses during the actual talk, on which the charge is based according to the distance covered; and the time which elapses during an interruption of a conversation from any cause, so that the interrupted time may be deducted from the total elapsed time in making the charge to the customer.

New Telephonic Improvements.

A LETTER from a Boston correspondent to the *Electrical Review* (Dec. 11) indicates that in this art the end of improvement has not yet been reached. The statement is made that the National Telephone Manufacturing Company has made some improvements, exemplified by the instalment of a new telephone exchange in Mobile, Ala., "which have proved an eye-opener to many interested parties." The instalment was made for the Home Telephone Company of Mobile, and is said to comprise "a number of important special devices put into practical operation here for the first time in an exchange. The switchboard already installed and now in operation has a capacity of eight hundred drops, five hundred of which are in use. No metallic-circuit construction has been necessary, induction coils have been dispensed with, and yet the service is completely free from all induction or cross-talk. These are points which cannot fail to interest every practical telephone man in this country.

"The instruments themselves consist of a small portable telephone only nine inches in length, and a magneto-bell-box about three and one-half inches cube. The telephone is simply a receiver and transmitter in combination. Pressing a key in the handle of the combination throws the drop at 'central,' and subscribers are able to communicate with each other in less time, while the system itself is more economical than anything now in use elsewhere."

The system is stated to be immensely popular with the Mobile public, proof of which is cited in the fact that the Home Telephone Company has given an order to the National Telephone Manufacturing Company to increase the instalment to twice its present capacity.

Another innovation made by the National Telephonic Manufacturing Company supplies a need for the better operation of trolley lines. By it the conductor of any car can at any time put himself in communication with headquarters, or with the power station, in case of a break-down or other emergency wherein he needs either aid or instructions. This device is thus described. "It consists merely of an ordinary No. 10 iron wire strung along the poles over the entire system, starting from and returning to the power house. Connected with this wire and at convenient distances apart are little water-tight switch boxes fastened on the poles. Each car is provided with a small portable combination receiver and transmitter, connected by a short cord to a contact plug. In the event of accident, the conductor can cut into the nearest switch box, press the key in the handle, and communicate immediately with headquarters. The few batteries necessary for the working of the line are located at the power house, and the whole outfit to be carried may be put into a coat-pocket."

The advantages of such a system are ob-

vious to any one at all conversant with the operation of trolley lines, and one can well imagine circumstances under which many times the cost of such a simple apparatus might be saved in a single year, or even a much less time.

Chronograph for Trolley Roads.

STILL another step in advance in the working of trolley roads has been made by a superintendent of a western trolley railroad. If well carried out, this device ought to be of great assistance in the control of a trolley line. It affords a means whereby the position of every car on the line may be known at all times at headquarters and in the power houses, so that, if, by reason of any obstruction, the cars get bunched on the line, this fact becomes known immediately to the persons in charge of the road. If any car gets crippled and is thus delayed, the fact that it has not reached a definite point at the proper time is known at once by those in authority. The device is described in *Boston Journal of Commerce* (Dec. 14).

"The chronograph consists primarily of a sheet of paper moving at a uniform rate under a series of pens or points, operated by magnets. Each magnet point represents a point on the road, and each time a car passes this point on the road it makes contact, and the magnet point on the chronograph makes a prick mark on the paper. The arrangement of parts is as follows: on the frame is mounted the back roller to hold a supply of paper, the front roller on which to roll up the record, the top plate holding the magnet points, and the top roller which gives the time movement to the sheet. The top roller is a series of grooved wheels, one for each magnet point. This is one of the most important parts of the device, as the movement of the sheet must be absolute and exact, or the time record will be inaccurate. This roller is operated by a high-class, powerful clock movement, which moves the time roller one revolution per hour. This is proportioned to give the paper exactly four inches of movement per hour, or one inch for every fifteen minutes; a line running on a one-minute schedule will, therefore, show fifteen cars or prick marks to the inch, a five-minute schedule three to the inch, and so on. A break of two inches would show a stoppage of thirty minutes at that point, and a record showing even, regular points indicates that cars are running all right at that point of the road. These sheets are dated and filed for reference, and thus a record of the operation of the road is kept, and improvement in service is bound to result from the information thus obtained."

Dry Batteries.

TWO forms of dry batteries which are simply modifications of the Leclanché primary battery are in the *Electrical Engineer* (London). The cuts herewith show the arrangement. The battery shown in Fig. 1 consists of a zinc vessel, D, forming one electrode and containing a black paste, *B*, in which is embedded the carbon electrode, *A*, and a white paste, *C*, surrounding the black paste. The formula for the black paste is as follows, the numbers given being parts in a total of 10,000:

Manganese dioxid, 757; carbon, 4,726; magnesia, 720; lime, 140; peroxid of iron,

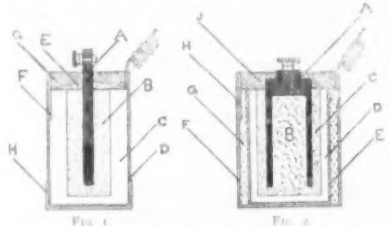


FIG. 1. FIG. 2.

212; ammonia, 1,278; water, 977; ingredients not determined, 1,190.

The white paste consists of lime, 2,089 parts in 10,000; ammonia, 2,029 parts; chlorid, 631 parts; water and binding material, 5,251 parts. A thin layer of silicate cotton, *E*, is placed over the pastes, and the cell is then sealed with pitch. Gas escapes through F.

The other form, shown in Fig. 2, consists of a zinc vessel, *E*, contained in a pasteboard cylinder, F, and surrounded by sawdust packing, *G*. The carbon electrode, *A*, is made in the form of an inverted cylinder, and the interior is filled with silicate cotton, *B*. Around the out-

side of the carbon cylinder is placed a paste, *C*. This paste consists of the following ingredients,—parts in a total of 10,000:

Manganese dioxid, 2,554; carbon, 1,602; silicate, 1,276; magnesia, 1,288; lime, 96; peroxid of iron, 346; moisture and ingredients not determined, 2,838. The white paste, D, consists of lime, 2618 parts; oxid of zinc, 600 parts; magnesia, 0.51 parts; ammonia, 249 parts; water and binding material, 6,482 parts.

This white paste forms a lining to the zinc cylinder, *E*, which is, of course, the negative electrode. A stout wire is soldered to the zinc cylinder to form a terminal, and the carbon is also provided with a brass terminal screw and nut. A waste tube, *H*, is provided, and the whole is sealed with pitch *J*.

THE ENGINEERING INDEX—1896.

Current Leading Articles on Applied Electricity in the American, English and British Colonial Electrical and Engineering Journals—See Introductory.

Lighting.

3020. Illumination vs. Glare. Albert Scheible (Consideration of light for the shop window, the home, and the street). Elec Eng-Dec. 11. 1700 w.

3128. Arc Lighting Progress. Alex. Dow (Reviewing the progress made in arc lighting during the last two years). Elec Engng-Dec. 3800 w.

3135. The Luminosity Limit of the Hydro-Carbon Flames. W. H. Birchmore (The first part treats of the changes produced in hydrocarbons by heat, and the physical changes involved in breaking a molecule). Elec Eng-Dec. 18. Serial. 1st part. 1700 w.

*3210. The Incandescent Lamp Question (An account of an interview with Messrs. Binswanger and Robertson, with tables). Ind & Ir-Dec. 13. 1100 w.

3249. Tests of the Moore Regulating Lamp Socket. William A. Anthony (Descriptive of two methods for decreasing the intensity of illumination in electric lights, with table showing results of experiments made to determine the comparative energy saved). Elec Eng-Dec. 25. 1000 w.

3250. Selection of Steam Engines for Electric Lighting Plants. Francis B. Crocker (The importance of the question. The proper size, number and type &c.). Elec Eng-Dec. 25. 2400 w.

3251. Loss of Revenue Due to Transformer Leakage Current. Spring S. Armstrong (Showing the poor economy of cheap transformers, and urging the use of the largest transformers possible, looking beyond the immediate future for economies to be effected). Elec Eng-Dec. 25. 1800 w.

*3308. Walsall Electricity Works. Ill. (Historical and descriptive). Elec Eng, Lond-Dec. 20. 5500 w.

*3311. The Development of a Low Pressure System. Ill. (Descriptive of the new works of the St. Pancras Vestry). Elec Rev, Lond-Dec. 20. 4500 w.

†3313. Practical Experience with Storage Batteries in Central Stations. C. L. Edgar (A paper read in the discussion of the storage battery before the Soc. of Elec. Eng. The author considers the uses to be 1. to carry the peak of the load at maximum hours; 2. to carry the entire load at minimum hours; 3. to act as an equalizer or reservoir; 4. for the equipment of annex stations). Trans Am Inst of Elec Eng-Nov. 3300 w.

*3316. The New 1000-Unit Machine at Deptford. Ill. (General remarks on the difficulties encountered by the London Electric Supply Corporation, followed by a description of the new engines). Eng, Lond-Dec. 20. 5400 w.

3503. The Mistaken Ideal of Artificial Light Improvers. W. H. Birchmore (Criticism of the work of Palaz, and a discussion with the object of showing that it is not in the dicta of a Bunsen photometer that we must find our standards, but in the brightness of certain colors and in the "spectra of reflection"). Elec Eng-Jan. 1. 2400 w.

3526. Central Station Working. Ill. Cecil P. Poole (The first part treats of combining steam and water-power electric plants). Elec Wld-Jan. 4. Serial. 1st part. 2200 w.

Power.

3014. A Giant Electric Crane. Ill. (Description of a high-speed electric hoisting and conveying machine used in ship-building. The Brown balanced cantilever electric ship-building crane at Newport News, Va., remarkable for its size, capacity, and the speed at which it travels). Elec Rev-Dec. 11. 1200 w.

3019. Eddy Motors in the Campbell Wall Paper Factory, New York City (Illustrated description of one of the most recent interesting examples of the substitution of electricity for the counter-shaft). Elec Eng-Dec, 11. 900 w.

3028. Power Plant of the Niagara Falls Hydraulic Power and Manufacturing Company. From *Canadian Journal of Commerce* (Descriptive). Power-Dec. 800 w.

3045. Storage-Battery Manipulations at the Boston Edison Station. Ill. (A description of the method of switchboard manipulations). Elec Wld-Dec. 14. 900 w.

*3097. Canet's Electrically Worked Turrets (Description with illustrations showing the arrangement of the turret, mountings, training gear, and ammunition hoist on board the Skjold). Engng-Dec. 6. 800 w.

3107. An Invention that Keeps Track of Electric Cars While in Operation (A system of

chronographic recording by which the position of trolley cars can at any time be known at headquarters or at the power-house). Bos Jour of Com–Dec. 14. 400 w.

3145. A new Design of Multipolar Dynamo. Ill. (A design built by the Triumph Electric Co. of Cincinnati. The chief point of superiority claimed is the construction of the magnetic circuits by which a greater efficiency is obtained). Elec Ind–Dec 500 w.

*3230. The Use of Dust Destructors as Steam Producers for Electricity Supply Stations. E. Manville (Paper read before "The Northern Society of Electrical Engineers." A description of the two installations being erected for the Vestry of Shoreditch and the Corporation of Swansea on what the writer believes to be the most suitable lines). Elec Plant & Ind, Lond–Dec. 1. 6000 w.

3245. The Evolution of an Electric Motor. Ill. Edward B. Rosa (A brief sketch of the evolution of the motor, as shown by a series of lecture experiments). Chau–Jan. 4000 w.

3261. The Electric Self-Playing Piano. Ill (Descriptive of an apparatus for attachment to any ordinary piano, enabling it to be played by electricity without the intermediation of any performer). Sci Am–Dec. 28. 800 w.

†3314. Past and Present Obstacles in the Storage Battery Development. Carl Hering (A paper read in the discussion on storage batteries). Trans Am Inst of Elec Eng–Nov. 3500 w.

†3315. Past Experience with Storage Batteries (Remarks by Frederick Reckenzaun, followed by general discussion of all the papers read on the storage battery question). Trans Am Inst of Elec Eng–Nov. 10800 w.

*3318. Electric Welding. Ill. (Describes a series of experiments carried out by the London Electric Supply Company at its works at Deptford. The examples of work done are very interesting. The welder was a 40 kilowatt, weighing 2800 lbs., with a primary current of 300 volts. The ratio of winding, of primary to secondary, was 300 to 1). Eng, Lond–Dec. 20. 700 w.

3383. A Suspended Beam Electric Tramway. Ill. (A modern method of handling furnace covers in a carbon plant). Elec Rev–Jan. 1. 1000 w.

3400. Storage-Battery Traction. J. Sarcia (The first number treats of recovery of energy, and calculation of the traction coefficient) From *L'Industrie Electrique*. Elec Ry Gaz–Dec. 28. Serial. 1st part. 1500 w.

3450. Electricity in Iron-Working (Discussing economy in motors, and examples of their use in iron works, with the methods of connecting). Ir Tr Rev–Jan. 2. 2500 w.

†3463. Some Recent Generators and Motors (Illustrated description of the generators and motors recently put upon the market by the Walker Manufacturing Company of Cleveland). St Ry Jour–Jan. 2800 w.

3514 Features of the Portland Transmission Hitherto Unpublished. Ill. George P. Low (Scheme of distribution for lighting and power circuits, and other interesting features). Jour of Elec–Dec. 1900 w.

3527. Notes on Accumulator Testing. Carl Hering (The object of the article is to point out some of the more important conditions under which tests are to be made, and to give hints regarding the carrying out of such tests). Elec Wld–Jan. 4. Serial. 1st part. 1800 w.

Telephony and Telegraphy.

3059. The New Home of the Postal Company at Chicago. Ill. E. J. Nally (Brief history of the progress of the Postal Telegraph-Cable Company, with description of their new building in Chicago). W Elec–Dec. 14. 5400 w.

*3133. Multiplex Telephony. Kempster B. Miller (A brief account of what has been done in this field). Sib Jour of Engng–Dec. 1200 w.

3136. Experimental Use of the Essick Page Printing Telegraph for Transmitting Information in Sea-Coast Artillery Firing, 1895. H. C. Carbaugh (Abstract from the *Journal of the U. S. Artillery*. Description of the test, with illustrations of the transmitter and receiver). Elec Eng–Dec. 18. 700 w.

3146. The Calculagraph in Telephone Service. Ill. (Describes an instrument for recording the time a telephone is in use). W Elec–Dec. 21. 1200 w.

*3227. Electrical Communication between Moving Trains (Descriptive of means of communication between passing trains, the object being to preserve a given space between those travelling on the same pair of rails). Elec Rev–Dec. 13. 400 w.

*3229. The Amazon Cable (An account of the work, about to be commenced, of laying a cable in the bed of the river, as the rapid growth of vegetation in tropical countries renders the maintenance of overhead wires very costly. Map). Elec Eng, Lond–Dec. 13. 500 w.

*3247. The New French Atlantic Cable (An abstract of the agreement in connection with the proposed new cable from Brest to Cape Cod). Elect'n–Dec. 13. 1300 w.

3262. The Cable Repair Steamer Mackay-Bennett. Ill. (Descriptive of a fine steamer owned by the Commercial Cable Co.) Sci Am–Dec. 28. 1500 w.

3382. The Hunnings' Transmitter (Statement by the Rev. Henry Hunnings). Elec–Jan. 1. 1000 w.

*3505. The Government of Norway and the Telephones. Alfred R. Bennett (Considerations which led to the decision against state acquisition of telephones). Elect'n–Dec. 27. 1800 w.

†3508. A New System of Machine Telegraphy. Patrick B. Delany, with Discussion (Touching upon the obstacles in the way of practical high-speed telegraphy, and explaining how, in the writer's opinion, these difficulties can be surmounted). Jour of Fr Inst–Jan. 3800 w.

3523. Telephone Service on Electric Railways. Ill. H. G.T. (The system installed by the National Telephone Manufacturing Company, of Boston, on the line of the Braintree and Weymouth road—its construction and operation). Elec Rev–Jan. 8. 900 w.

*3535. Mechan & Sons' Triple Automatic

Reply Ships' Telegraph (Illustrated description.) Steamship-Jan. 500 w.

†3547. Cable-Repair Ships of the World and Their Work. Ill. Gustav Heinsohn (An historical account of what has been accomplished in this field, the difficulties overcome, and many points of interest). Ind Rub Wld-Jan. 10. 2800 w.

Miscellany.

*3012. The Commercial Exploitation of Electricity. Burton E. Greene (Showing how the mania for speculation has prevented the electric light and power industries profitable commercial returns). Eng Mag-Feb. 5000 w.

*3083. Note on Tinfoil Grating as a Detector for Electric Waves. T. Mizuno (From the *Journal* of the College of Science, Imperial University, Tokio, Japan. An account of experiments and a few tests of the sensibility of tinfoil grating as a detector of electric waves). Elect'n-Dec. 6. 1500 w.

*3130. Simple Analytical Theory of the Transformer. Frederick Bedell (Mathematical). Sib Jour of Engng-Dec. 1200 w.

3133. Electricity at the National Capital. George H. Drayer (An account of changes recently made, or soon to be made, in the Capitol at Washington, for utilizing electricity in many ways). Elec Rev-Dec. 18. 1100 w.

3134. Charging Storage Cells for Signalling Purposes. A. S. Hubbard (Illustrated description of a switch, which, operated by the starting and stopping of the dynamo, automatically changes the sets). Elec Eng-Dec. 18. 400 w.

3137. Put a Premium on Safe Wiring. Edward H. Johnson (Paper read at the meeting of the Underwriters' Nat. Elec. Assn. Favoring iron armored conduits). Elec Eng-Dec. 18. 1200 w.

3142. Changes in Underwriters' Rules (Result of the work of the Electrical Committee of the Underwriters' National Electrical Association, providing for a number of changes and additions to the present code of inspection rules of that body). Elec Wld-Dec. 21. 1700 w.

3143. New Features in Electric Advertising. Ill. (Descriptive of some of the ingenious devices produced by electricity). Elec Wld-Dec. 21. 1000 w.

3144. Frequency-Changing and Single-Phase Alternating-Current Motor Transformers. Ill. F. Jarvis Patten (Explanation of the general system, and describing a system in which it is claimed the magnetic effects will be found almost constant). Elec Wld-Dec. 21. 1200 w.

3165. Electric Registering Water Level Indicator. Ill. (Description of a registering indicator recently brought out by The India Rubber, Gutta Percha and Telegraph Works Company). Sci Am Sup-Dec. 21. 1200 w.

*3228. Crompton Improved Bifilar D'Arsonval Galvanometer (Illustrated description). Elec Eng, Lond-Dec. 13. 1200 w.

3277. Electricity at the Atlanta Exposition. Ill. Charles F. Foster (Full description of arrangements for lighting, and electrical exhibits). Elec Wld-Dec. 28. 4500 w.

3294. Use of Static Electricity in a Bottle-labeling Machine (Illustrated description). W Elec-Dec. 28. 1800 w.

3295. Tendencies of Modern Electrical Research. M. I. Pupin (An address delivered before the N. Y. Acad. of Sciences. Tracing the development of the science of electricity, and showing how the domain of electricity is being extended). Science-Dec. 27. 10900 w.

*3312. The True Resistance and Back E. M. F. of the Arc. W. E. Ayrton (Pointing out some errors of Silvanus Thompson, with explanations). Elec Rev, Lond-Dec. 20. 2000 w.

*3353. The Electrical Patents of 1894 (Electrical patents granted in this year by the United Kingdom, United States and Germany, number 3315. The number granted in each country is given; also those applying to the different branches). Engng-Dec. 20. 700 w.

*3360. Notes on an Investigation of the Alternating Current Arc. J. A. Fleming and J. B. Petavel (Results obtained in investigations recently carried on in the electrical laboratory of University College, London). Elect'n-Dec. 20. 3500 w.

*3361. Speed-Voltage Curves. J. Alfred Griffiths (A method of investigation useful to students and of interest to experienced electricians). Elect'n-Dec. 20. 2500 w.

†3374. The Electric Furnace in Chemistry. M. H. Moissan. Translated from *La Nature* (A review of the work accomplished by the use of the electric furnace, and showing that it is having an important effect on the industries). Pop Sci M-Jan. 1200 w.

*3415. The Geometrical Form of Transformer Plates. George Adams (Treating of the best form of plate, with illustrations and comments). Elec Rev, Lond-Dec. 27. 900 w.

*3416. Energy Losses in Dielectrics (A review of the work done by investigators of this subject). Elec Rev, Lond-Dec. 27. 1200 w.

3441. Electrotechnics. Ill. Frank S. Mason (Will cover the science of the methods, processes and operations in which electricity is applied in the industrial arts, the relations between electricity and magnetism, and the phenomena due to those relations. The first part contains a brief historical sketch, a list of units, and a criticism of the definition of the watt, as given in Houston's electrical dictionary). Am Mach-Jan. 2. 1800 w.

3456. Electrical Development in the South (The record of the year comprehensively reviewed; interesting electrical installations; applications of electricity in industrial operations). Tradesman-Jan. 1. 7500 w.

*3506. Electrodynamic Rotations Produced by Means of Alternate Currents. Galileo Ferraris, with Editorial (A paper read before the Turin Academy in 1888, and translated at this late date because of its importance to many readers). Elect'n-Dec. 27. 4500 w.

3525. D'Arsonval's Treatment for Electric Shock (Abstract of report of committee of electrical experts appointed by the Paris Academy of Medicine). Elec Rev-Jan. 8. 1200 w.

INDUSTRIAL SOCIOLOGY

Both Sides of Profit-Sharing.

THIS subject is treated interestingly in Appleton's *Popular Science Monthly* for January by Mr. Frederic Mather, who sees no immediate prospect of ending the contest between capital and labor, and who maintains that "the establishment of boards of arbitration will not meet present difficulties. That which one side calls reasonable and equitable will often be considered unreasonable and inequitable by the other side, and arbitration will not change the opinions of the defeated side. When it results in a compromise, it generally suits neither party to the controversy, because in such cases both sides have relinquished something that they think should, in justice, have been accorded to them.' Mr. Mather's opinion is that "the fatal defect in treating the labor problem . . . . has been the stress laid upon change of method," whereas it is a change of spirit in both parties to the controversy that is needed. Quoting Dr. Channing, he accords with the view of that eminent divine that "the only elevation of a human being consists in the exercise, growth, and energy of the higher principles and powers of his soul," and thinks that, while the only practical way in which this can be brought about is by the system of profit-sharing, even this method is practicable only within certain limits.

A number of examples of profit sharing enterprises are adduced to show what has been and can be done in this way. Some of the most successful attempts at applying this system have been in France.

"In 1844 the Paris and Orleans Railway Company adopted the principle. Between 1844 and 1882 about twelve million dollars were distributed as profit dividends among the employees, while the wages paid to them were equal to those paid by roads that gave their employees no share in the profits; and at the same time the dividends to the stockholders were as large as they would have been, had there been no profit-sharing. Students of political economy are familiar with the Ateliers Socialistes of Paris. Many of the smaller enterprises in the same city have also applied the system of profit-sharing with remarkable success, one of the most conspicuous being the Atelier de Broderies of M. Nayrolles. In this establishment the system is carried out among a *personnel* composed exclusively of women, and with astonishing results both with the quality of the work and the increased wages of workers."

The example thus set has been recently followed in England and in America. Of these a number of examples—that is, of experiments which have succeeded up to the present time—are cited. Chicago, that wonderful city of rapid growth and prodigious enterprise, has several profit-sharing establishments, and others in New York and Philadelphia are named.

"After several experiments in other lines, a publishing house in Chicago adopted profit-sharing about fifteen years ago. The house has increased its capital stock more than once; and many of its men, who were ordinary workmen under the old system, now own their homes and are worth from five to fifty thousand dollars each. In another establishment, also in Chicago, those who had been in the employ of the company for one year or more were informed that, if the amount of their sales for six months should exceed the total for the same period of time in the previous year, they would be allowed a commission on the excess. The commission averaged 2½ per cent. The employees at once increased their efforts to sell; and, when the first distribution was made, last July, it was found that several of the girls had nearly one hundred dollars as their share of the profits for six months."

The author does not, however, regard these and other attempts at putting the system of profit-sharing into practice as conclusive that it will or can become uni-

versal, notwithstanding the obvious benefits it confers in times of prosperity. Profit-sharing enterprises have yet to pass through the fires of adversity to prove what power of endurance they possess. The case is thus put by Mr. Mather:

"But can any one guarantee to the employer that every year willl be a profitable one? And, if there are losses, who shall make them up? Shall the employers make them up by themselves, or shall the men, having once been taken into a partnership upon the profits, still continue that partnership by making up their share of the losses? There are many employed men who are the owners or the partial owners of their homes. They would gladly enter into an arrangement for the division of the profits, but they would hesitate to mortgage their homes as security for their proportion of the losses in a bad year. Other employees could offer no security whatever in such a case; therefore, the losses must come upon the employers in the end. It is this fact, more than any other, that hurts the prospects of profit-sharing. Such an arrangement can not be in the nature of a true partnership, because, as noted above, there is a partnership so far as the gains are concerned, but the partnership ceases when there are losses. Hence, as at present tried, the system of profit-sharing is really a gratuity on the part of the employers, most of them having taken the ground that they must average their good years in order to keep their men employed uniformly."

The lack of a contingent fund to tide the employer over bad years is noted as a weakness of the system. The small effect of the system in increasing sympathy between employers and employed is also noted, and the conclusion is reached "that neither profit-sharing nor any other device will improve the present situation, so long as there is a lack of sympathy in either side toward the other. The employers and the holders of great wealth should regard themselves, not as mere irresponsible giants of finance, but as sacredly responsible to society for the large interests that have been intrusted to them. The too frequent want of such a broad idea of his functions has led the public to believe that the capitalist is a man who absorbs all the toil of the laboring man, leaving to the latter a very uncertain subsistence. Nor does the capitalist have credit for the fact that, without him, labor would not be so productive, and for the further fact that his share is taken from a product that was created largely through his direction, his enterprise, and his resources. It makes a vast difference whether an army has a skilful general at the head, or only an ordinary leader"

Finally, unless both capitalists and workmen come to regard every kind of honest occupation as honorable, "neither profit sharing or any other form of effort will be able to bridge the chasm."

Profit Sharing.

IN line with the preceding review, an editorial on "Experience with Profit-Sharing" (*Engineering*, Dec. 27) takes a commanding view of the system and its present status in the world's industry.

The system is regarded as ideal in the principles of equity upon which it is based. The simplicity of the scheme attracts attention. Its ready application also commends it; yet the fact remains that a large majority of attempts to apply it have failed. A few successes may be scored on the credit side of the account, but the permanency of these successes, in view of the failures, the inherent nature of trade, and the characteristics of human nature, is still problematical.

"The experience of years is told in part by a report lately issued from the labor department of the board of trade. It can scarcely be said, after careful perusal of the report, that hopes have attained fruition. In the first place, profit-sharing, as first conceived, has been found almost impracticable, and, where possible, has been without appreciable result. Only the most sympathetic expected that it would be otherwise. The conditions required a mental, if not a moral, training which the weekly or fortnightly wage did not inculcate. Reward quickly follows efforts in the case of the ordinary wage; in the

other, it is so remote as to prove no incentive, except to the more thoughtful and energetic workman. And, after a time, even his enthusiasm is affected by the lack of interest of his neighbor. 'To a man living from hand to mouth, the hope of receiving a reward at some distant period offered but little inducement towards higher efficiency.' That is the view suggested by experience to Mr. Towne, of the Yale and Towne Company, Stamford, Conn. It was thought that this lack of interest in deferred results would be less operative in small works employing twenty persons. The system was adopted in 1893, when the bonus was 10 per cent. In 1894, it was 1.65 per cent. The basis was the same; the difference 'is accounted for only by the fact that the men did not work so hard.' That is the view of the firm in question. Again, in a skin-dressing factory the departments were divided, and the amount of bonus was based on the saving in production in each. Thus, in 'dressing,' the men earned 7½ per cent.; in dyeing, 10 per cent., in finishing, 5 per cent.; and in fellmongering, about 8 per cent.,—in the first year (1890). But since then no bonus has been earned. In regard to the effect of the system, the firm write that the result was fairly satisfactory, but, in consequence of the system possibly, one department was over-jealous at first of another's large bonus, and the indifference subsequently was rather marked.

"This element of jealousy, in cases where profit is credited to separate departments, is most pronounced in individual work or in small groups, and is almost fatal to any scheme, for it begets the feeling that there must be unfairness in any arrangement which admits of one man earning a larger bonus than another. It is idle to offer explanations to the men, since a full statement cannot be given. The disclosure of a firm s financial affairs to the workmen would be injudicious, and this fact tends to make any profit-sharing scheme a one-sided arrangement. On the one hand, faith is commanded; on the other, a strong will against temptation. But to counterbalance this there is the still more unsatisfactory one-sided arrangement that all profit is shared, while the loss is borne by the employer."

The inference is plain that, unless profit-sharing shall be extended to loss-sharing including the latter as rigidly and inexorably as the former, and that, unless workmen can be admitted to a share in management, at least to an extent that will satisfy them that such management and its record in the counting-room is as much in their own interest as in that of the heads of the establishment that employs them, seeds of discontent will exist, ready to germinate into a crop of disturbance as soon as favoring conditions for its growth are established.

The sort of half partnership involved in any system of profit-sharing yet put into operation cannot, however it may temporarily succeed, ever take the place of real and complete partnership. While admitting the equity of profit-sharing, we, therefore, hold that, if principles of justice are to rule, other equities must be considered, and that, however successful an experiment in profit-sharing may appear to be, these other equities will in the end force themselves to the front as elements no longer to be ignored. The system, moreover, has other limitations.

We fully concur with *Engineering* in the belief that what is called "gain-sharing" must necessarily be confined to such work as is repeated indefinitely, with few alterations. This system contemplates the sharing of gains after losses are deducted from gross profits. But many of the difficulties inherent in profit-sharing will cling to a gain-sharing system as well. For instance, losses might occasionally be so large as to more than absorb the total profits, thus creating a deficit. It is easy to foresee what discontent would be aroused under such a condition. The objection that a true partnership does not exist, unless the workmen are admitted to the secrets of the counting-room and private office and to participate in the management, is just as forceful in the one case as in the other.

Engineering remarks, concerning an experiment in gain-sharing made in 1887 by the Yale and Towne Manufacturing Com-

pany, that it "had several recommendations. In the first place, the reward was paid monthly. It was based on a liberal scale of standard costs, and was put into operation for five years, both of which were recorded as essential conditions to encourage the men to do their best, in the knowledge that a big bonus did not involve a speedy decrease of the standard cost. Moreover, standard costs were determined for such small products that individual exertion carried its own reward in most cases. The rate of dividend was from two to twelve per cent. on the wages, while at the same time the cost of production was proportionately decreased, for the half of the gain went to the employers, and the turn-out was greater, while establishment charges remained constant.

"It will be at once apparent that the plan is limited in its application practically to standard productions,—almost to such work as is repeated indefinitely with few alterations. Where the product is a specialty, and a man or boy is kept at one machine turning out, say, bolts or studs, it is easy to determine the standard price. But even the Yale and Towne Company, enthusiastic as they were at one time, were forced to replace the system with a well-organized piece-work system, because, the groups restricted even to twenty, the want of uniform individual effort defeated the object. The chief reason, however, was that the products were of such infinitely varied character that it was found better to have a system where each man was directly interested in his work. 'The men seem better satisfied with the piecework system,' and the company got 'decidedly' better results than under the gain-sharing system. To quote again from Mr. Towne, 'the cost of articles has been greatly reduced; but it must be stated that this is probably due to the fact that piecework has taken the place of day work, and that the dropping of gain-sharing has made but little difference one way or the other.' The point is that piecework is more effective and more acceptable to the men than gain-sharing."

A number of other examples, illustrating the argument, are adduced, and the able editorial concludes with an unanswerable argument in favor of a well-devised piecework system, whenever the nature of the work admits of its practical application.

"A piecework system, to be fair, should be reasonably liberal, and, where possible, rates should be permanent over a period of years. No more effective cause of discontent can be suggested than the reduction of piecework rates as a sequence to the earning of big wages. This is often practised by the over-zealous foreman, sometimes without the knowledge of the employer, although we fear at other times with his tacit approval. This especially so with squad piecework, and it has resulted in extraordinary effort being required for little more than 'time and quarter' wage. We are satisfied that in ordinary cases, where a fair contract rate is offered as the equivalent to the standard cost, pieceworkers will attain for employers the same degree of efficiency as with any gain-sharing scheme. Careless work but indicates too often the lessening of rates of remuneration. And, as for the drones in the hive, the pieceworker will as quickly get rid of him as did the good-fellowship worker at the Thames Iron Works, where three hundred or four hundred were discharged in a few months at the request of 'the fellowships.' Moreover, there is no great objection to the drones ultimately uniting together as a squad. The other advantage of profit-sharing in the direction of ingenuity can easily be covered by awards for inventions, —an arrangement which readily appeals directly to most men,—while the detection of flagrant waste of material is the duty of the foreman. Like the workman, he need have no special incentive to duty, although the steady growing practice of presenting a *douceur* at the end of the year, which may or not be in proportion to the year's profit, is commendable and a special incentive. But, for this *douceur*, let there be no nibbling at piecework contract prices."

The impracticability of the system as a general panacea for industrial woes, unless human nature be changed, is apparent.

Cotton Mills in the Southern States.

INDICATIONS of a growing fear that British commercial supremacy is threatened by American enterprise are multiplying in the English technical and trade journals. One of the latest is an article in *Machinery* (London, Nov. 15) by a writer who seems to have studied the rapid development of the cotton industry in the southern States, and to realize its full significance. His article is interesting as exhibiting the conclusions reached by an intelligent Englishman in a tour of observation among the southern cotton mills, as containing some rather highly-colored statements relating to the conduct and management of these mills, and as giving a very fair view of the peculiar social conditions that favor the extension of the cotton industry in the south.

The observations of this tourist appear to have been chiefly confined to North and South Carolina, Virginia, and Georgia, which are fast coming to the front as cotton-manufacturing States, — Massachusetts, however, still retaining the lead. He says:

"Scores of mills in the north have had to change over to medium and finer counts because of the far lower cost of production in the States named compared with the northern and eastern States of America. The south has beaten them out of the market on nearly all grades of brown and colored (heavy goods), such as sheeting, drills, shirtings, domestics, duck, demins, plaids, cottonades, tickings, plain ginghams, 2-, 3-, and 4-box ginghams of two or more harness (heald) work. And at the present time there are more than two hundred mills throughout the south running successfully and reaping the finest dividends in the world (some declare ten to thirty per cent. per year), besides large surpluses for additions, machinery, etc., and sinking fund. Besides supplying the home markets with considerable quantities of goods, they also do a magnificent trade with China, Central and South America, Mexico, and Japan, and they also ship checks, plaids, drills, and plain ginghams to France and Dutch countries, and one of the largest mills of the south, the John King Manufacturing Co., of Augusta, Georgia, sends cloth directly to Manchester, right into our own markets, if you please. The writer was with a large mill of this kind, and *Machinery* readers will please cast all prejudices at one side when reading the facts and figures, which are given for the benefit of mill men. In one large mill in South Carolina, where brown goods of coarse counts and light pick and reed are manufactured, the cost of production per pound throughout the different parts of the mill are as follows:

"Cost of production per pound: carding, 0.35 cents; ring-spinning, 0.36 cents; warping, winding, and slashing, 0.28 cents; weaving, 0.93 cents; a total of 1.82 cents. This includes labor and room management only, exclusive of other expenses.

"The management of the mills receive large salaries, but deserve every dollar they get. It varies from four to ten dollars per day for weaving department managers, and those controlling other departments get from three to six dollars, according to locality, size of mill, and quality of goods, etc. The superintendent receives from three thousand to six thousand dollars yearly, besides other income which those gentlemen keep quiet about. The help are mostly natives, and first-class workers they are under conditions of temperature they must work in.

"The general average of earnings is seventy cents per hand per day, and they are satisfied with whatever they receive. In the cities they pay more than in the country. In fact, some places do not pay out anything, and paper is discounted at the corporation's store in the village for its face value. The only reason that can be given for hands working year out and year in for such remuneration is their strong attachment to the locality where they were born and raised.

"Working hours are sixty-six to seventy-two per week, and machinery is kept at full speed. Two or three score mills are running five nights per week, with two forces of help. The country is magnificent, and there is water power all over the south in abundance, and it can be bought at a reasonable figure, and land is given away to

manufacturers for building purposes. Several cities own splendid water powers, which are very powerful all the year around, and are rented out very cheaply. The city of Augusta, Georgia, rents its power at $5.50 per horse-power per annum, and takes all responsibility of repairs. The city is supplied by the Savannah river. Water power on Cataoochee river is leased for $4.20 per horse-power per annum."

We are not responsible in this review for this writer's exaggerations and misconceptions. Southern labor is highly spoken of. It is claimed that it produces "as much as any northern or imported help in the east," and asserted that it would undoubtedly produce more, if artificial means were supplied to cool the temperature in mills during the summer months. The quality as well as the quantity is surprising to our English tourist.

"Many men and women weavers produced 88 per cent. of the speed of the loom on heavy ducking, where change of shuttles is very frequent, and looms ran at a speed of 175 picks per minute (45 in. reed space). Each weaver minds seven looms. The loom fixers (tacklers) do not attend a loom until the red flag is put up. Each weaver is supplied with a red flag, and is ordered to stick it on the loom whenever they want the fixer, and they must leave it up until that man should attend. If it remain up too long, the overseer or assistant wants to know the reason why, and 'wrangling' or hard looks between fixer and weaver in that country are not seen. If there were either, one or both would be laid in 6 ft. by 2 ft., in short order, as 'dead as a doornail.'"

The following statement is quoted as one of those amusing misconceptions which foreigners sometimes acquire during a rapid tour in America.

"All overseers and superintendents, and most help, carry revolvers and knives continually. Some of them conceal the weapons, and some of them are quite open for everybody's inspection. And neither manager nor employee (whether man or woman) will listen to the least insult, nor stand any fooling, but will resent it by force. It is a novel sight to go into some southern mills where firearms are carried. This must not be taken to mean that southerners are desperadoes and criminals,—not at all. They are the most civil-spoken (they have to be) race. An English manager who would try in the south to manage a mill on the same plan as in Lancashire would receive two hours' notice to quit, and his life would not be worth a cotton-seed if he refused to comply.

"Cheap cotton, cheap labor, and cheap coal; low price of water power; freedom from taxation from ten to fifteen years for new concerns; fair transportation rates, etc.,—are the chief elements which enable the southern manufacturer to compete with any other part of the world. This is no experiment, for there are seventy new mills in construction and starting up at present; and there is native help for one hundred more, and the people can be taught very quickly, and become splendid workers. Living is cheap, and everybody grows his own vegetables. Some operatives use oil or gas stoves for cooking and little fuel is used. No underclothing is requisite, and a few dollars completes an outfit."

An Important Lesson.

ONE important lesson, says the Progress of the World for January, which the December panic and recovery must have taught the international banker (and it is one which may stand this country in good stead on some future occasion) is that the National policy of the United States is not capable of being controlled by pocketbook losses. It is also apparent that no premeditated policy, directed against Wall Street values, would suffice to induce us to recede from what we considered to be a righteous position. We have demonstrated our self-reliance, too, in a most striking manner. The banks of New York, as soon as practicable after the blow had fallen on securities at the Stock Exchange, decided, by the authorization of the issue of Clearing House loan certificates, to virtually consolidate all their resources, the strong upholding the weak, and thereby to assure the prevention of default or insolvency on the part of any merchant or brokerage

house whose assets were ample, but who might not, amid the cycle of panic, be able to liquidate them to advantage. The promptness of this action was at once effective in allaying financial alarm, and even in the face of a hesitating and still nervous London market, our home securities rallied promptly almost to the basis from which the precipitate decline began.

There is ground for hope that the influence of the United States as a new political factor in the possibilities of international finance may work in the interests of peace and stability. On the surface, the danger of sudden war alarms in which this country may be concerned may not seem to promise much in these directions. But is it not reasonable to suppose that the directors of the financial world in Europe —the great bankers of London, Paris and Berlin—will be more observant hereafter of the course of European diplomacy concerning matters in which the United States are interested, and may on occasions lay cooling hands on the feverish pulse of some foreign "Jingo" statesman?

THE ENGINEERING INDEX—1896.

Current Leading Articles on Industrial Sociology in the American, English and British Colonial Magazines, Reviews and Engineering Journals—See Introductory.

*3003. Jingoism, or War upon Domestic Industry. Edward Atkinson (Showing the effect of an aggressive foreign policy upon industry and commerce, and proposing an international union for the maintenance of justice between nations). Eng Mag-Feb. 4500 w.

*3010. Our Commerce with Latin America. Emilio M. Amores (Reviewing the natural resources of Latin American countries and the conditions upon which the United States can secure an increased share of the commerce therewith). Eng Mag-Feb. 4700 w.

†3016. Physics and Sociology. W. H. Mallock (The first part is a dissertation on the application to social phenomena of the methods and principles derived from physical science, and on the crucial difference between the subject-matter of physical science and that of social science, which render the methods of study proper to the first inadequate when applied to the second). Contemporary Rev-Dec. Serial. 1st part. 13000 w.

†3049. Interstate Tariffs in Mexico (Advance sheets of Consular Reports). Dec. 2300 w.

†3117. England in Nicaragua and Venezuela. G. H. D. Gossip (A consideration of the subject from an American point of view). Fortnightly Rev-Dec. 6500 w.

†3168. Rural Loan Associations in Germany. H. F. Merritt (Origin, development, and effects of mutual benefit associations in Germany). Advance sheets of Consular Reports. Dec. 3300 w.

†3169. Agrarian Movement in Germany. Charles de Kay (Particulars of a growing organization in Germany and its present resources; its purpose being to establish banks and by advancing money on crops to rescue the farmers from middlemen, alleged to be preying upon them. It also has the character of a political party). Advance sheets of Consular Reports. Dec. 1500 w.

3222. Analysis of Ten Months Foreign Trade (Review of the detailed statement of the Bureau of Statistics). Bradstreet's-Dec. 21. 900 w.

3231.—$1. The Theory of Social Forces. Simon N. Patten (An attempt to recast current social philosophy and to introduce into it elements which thus far have been overlooked. It considers the influence of the environment; race psychology; knowledge and belief; a social commonwealth; and normal progress). An of Am Acad-Jan. 150 pgs.

3232.—$1. The Nicaragua Canal and the Monroe Doctrine. L. M. Keasbey (An outline of the issue between England and America in the case of the Nicaragua Canal Route. An interesting historical review). An Am Acad-Jan. 11500 w.

3234.—$1. The Nicaragua Canal and the Economic Development of the United States. E. R. Johnson (The writer believes that the future industrial and commercial development of the country is largely conditioned upon the early construction of this canal. He gives a brief outline of the influences it will exert, showing that the benefits will be shared by all parts of the country). An Am Acad-Jan. 4000 w

*3244. Money in Legislation. Sidney Sherwood (A review of the present monetary situation and its causes). Chau-Jan. 4000 w.

*3258. Trade and Industry of New Caledonia and Tahiti (Descriptive of the people and their work; the facility with which the white man becomes acclimatized; the resources, &c). Bd of Tr Jour-Dec. 1800 w.

*3259. The Competition of the Industries of Japan with Imports from Europe (The productive capabilities of Japan are briefly discussed with special reference to their influence on German export trade). Bd of Tr Jour-Dec. 900 w.

*3260. Tariff Changes and Customs Regulations (Russia, France, Portugal, Spain, Bulgaria, Turkey, United States, San Salvador, British India, Cape Colony). Bd of Tr Jour-Dec. 4600 w.

We supply copies of these articles. See introductory.

*3296. Some Suggestions on Currency and Banking. Adolf Ladenburg (A brief review of the currency question, and suggesting as a remedy for existing evils, the development of our clearing-house system). Forum–Jan. 2200 w.

*3297. Railroad-Rate Wars; Their Cause and Cure. John W. Midgely (A statement of the conditions out of which present evils have grown, with suggestions of the remedy). Forum–Jan. 5000 w.

3343. Mercantile Failures for 1895 (Tables of embarrassments and failures for the year, with assets and liabilities, arranged by states). Bradstreet's–Dec. 28. 1200 w.

3344. Great Britain's Declining Colonial Trade (Editorial on the dislodgment of British colonial trade by Germany, France, Belgium and the United States). Bradstreet's–Dec. 28. 1200 w.

†3373. Both Sides of Profit-Sharing. Frederic G. Mather (The system discussed and many examples cited where the benefits have been mutual, but concluding that neither profit-sharing nor any other device will improve the situation, if there is lack of sympathy on either side toward the other). Pop Sci M–Jan. 2500 w.

*3375. The Law of Demand in Work. William B. Chisholm (An essay on the dignity of labor and its beneficial effects). Am Mag of Civ–Jan. 2700 w.

*3376. Reality vs. Romance in Economics. T. E. Willson (An effort to show that the idea that the United States is a debtor nation is erroneous). Am Mag of Civ–Jan. 2200 w.

*3377. The Ethics of Commerce. Allen Ripley Foote (Showing that commerce cannot thrive where man's natural rights are not recognized. Giving examples of various forms of injustice, dishonesty and fraud and their effects). Am Mag of Civ–Jan. 1500 w.

*3378. Indian vs. American Cotton-Mill Operatives. J. W. Bennett (A brief account of the very cheap labor in the mills of India, and the simple way of living, in contrast with that practiced by workers in the same field in America). Am Mag of Civ–Jan. 800 w.

*3379. Practical Bimetallism and Ideal Protection. Frank Rosewater (The conclusion reached is that genuine exchange can be possible only on the basis of a uniform standard of values A new system is proposed with reasons. The writer thinks that if affairs are guided with reason, an unprecedented period of prosperity is before the country). Am Mag of Civ–Jan. 6000 w.

*3380. Sociology and Criminology. Clark Bell (From advance sheets of the *Medico Legal Journal*. The study of the criminal instead of the crime). Am Mag of Civ–Jan. 900 w.

*3471. Experience with Profit-Sharing (An able editorial reviewing principally American experiments in this line, and pointing out the limitations which restrict its application, these being found both in the nature of trade and in human nature. The piece-work system is considered preferable). Engng–Dec. 27. 4500 w.

*3493. Representative Women on the Vital Social Problems. I. Henry George and Nehemiah. Celia Baldwin Whitehead. II. How the Single Tax Will Free Men. Estella Bachman Brokaw. III. Notes in Reply. Frances E. Russell (Those who wish to study the workings of the feminine intellect, in discussing great public questions of political economy, will find an interesting opportunity in this symposium). Arena–Jan. 6500 w.

*3494. Should the Government Control the Telegraph? (A continuation of the symposium on this subject). I. Postal Telegraph. Lyman Abbott. II. Why I Oppose Governmental Control of the Telegraph. William L. Wilson. III. Why the Government Should Control the Telegraph. Frank Parsons (Dr. Abbott advocates the scheme and gives his view of the advantages of the plan. Postmaster-General Wilson follows with a strong argument against the scheme, holding that it could only be operated at a yearly loss, and also questioning its general feasibility under our political system. Prof. Frank Parsons takes sides with the advocates of the scheme, taking the radical ground that it is a question of the people vs. monopoly). Arena–Jan. 7000 w.

*3495. The Bond and the Dollar. John Clark Ridpath (A remarkable essay. The startling statement is made that the national debt of the United States, in its bonded and unbonded forms, will purchase as its equivalent in value as much of the average of twenty-five of the leading commodities of the American market, including real estate and labor, as the same debt would purchase at its maximum on the 1st of March, 1866. The people have paid and paid for thirty years, and at the end have paid just this—NOTHING! A formidable array of statistics is presented to sustain this statement. The article is in the nature of a general protest against the method of raising money for governmental purposes by bond issues). Arena–Jan. Serial. 1st part. 4800 w.

*3518. The Progress of Banking in Great Britain and Ireland during 1895 (Exhaustive survey of the present status of banking operations, with copious statistics. The conclusion arrived at is, that after the previous years of financial disturbance, the banks of the United Kingdom are tending to resume their normal condition). Banker's Mag–Jan. 6500 w.

*3519. The United States Gold Problem. W. R. Lawson (A criticism of Pres. Cleveland's financial policy, being specially severe upon his attitude toward the greenbacks, claimed to be the only sound currency in the Union. The banking system of the United States is also severely criticised, but it is deemed to have taken too firm a hold on the people to admit of any hope of disestablishment). Banker's Mag–Jan. 6000 w.

*3520. Monetary Review for the Year 1895 (Market features of the year; trade in 1895; eastern and foreign exchanges; politics; banking, etc). Banker's Mag–Jan. 3300 w.

MARINE ENGINEERING

Water-Tube Boilers in Marine Service.

IN this department for January we printed a review of a paper entitled "Tubulous Boilers in the French Navy." The paper was prepared by Assistant Engineer Robison, of the United States navy, and published in the *Journal of American Society of Naval Engineers*. It purported to give conclusions derived from personal observations; and from the character of these conclusions, and the reputation of its author, it has attracted an unusual amount of attention.

In *Engineering* (Dec. 13) Messrs. Maudsley, Sons and Field, manufacturers of the Belleville boiler in England, who have placed it on a number of British warships and some merchant vessels, take exceptions to Mr. Robison's paper in general, and to his statement regarding the Belleville boiler in particular, and subject the paper to criticism so severe that probably it will call out a rejoinder. In this review we shall attempt to give only a summary of the first part of the communication of Messrs. Maudsley, Sons and Field, which occupies over four closely-printed columns in *Engineering*.

They assert that Chief Engineer Robison's paper needs explanation in some parts, and contradiction in others, thus raising questions of fact calculated to throw discredit upon the accuracy of the author's observations.

To the statement that automatic feed-regulators have been made necessary by the adoption of the Belleville boiler in the French navy, they reply that such regulators are not now unusual, and predict that they will before long become common on the higher-class steamers. The objection that they were once sources of danger through incrustation of floats and working parts no longer holds against them, since filters and evaporators have become efficient aids in purifying water.

The statement that tubes deteriorate through imperfect circulation is characterized as "untrue." The Ortegal, a vessel in continual service for ten years, is cited as an example, the tubes having given no unusual trouble during that period.

The correctness of the statement, as to priming, that the steam contains ten per cent. of water is also denied, and it is alleged, on the contrary, that water is carried over only on starting the engines, and that, thereafter, as shown by the French experiments, the steam is superheated.

As to economy, the statement is made that the evaporative efficiency of the Belleville boiler is higher than that of the single ended boiler when worked under precisely the same conditions. This is affirmed to have been the case in a majority of trials, which, moreover, have indicated superiority in this respect over the double-ended boiler.

It is denied that the feed-pumps, as compared with other pumps of a similar class, require an undue amount of steam to drive them, as was asserted.

The statement that "the accessories of the boiler are so numerous that they make a considerable addition to the machinery of a vessel" is declared to be a misrepresentation, as is also the statement that "the repairs to the boilers are more costly than those for ordinary boilers." The superintending engineer of the Messageries Maritimes Company is quoted as stating that the repairs to Belleville boilers on the ships of the company are from two to three per cent. less than those required by their cylindrical boilers.

The statement that ships fitted with Belleville boilers "have more boilers than are necessary to the running of the engines at full power" is also pronounced a misstatement. This error might have grown out of the fact that, while the "Messageries Maritimes steamers were built for 17½-knot speed, their mail-contract calls for an average passage of only 15 knots. Hence they have an excess of boiler power for the required speed, but not for their de-

signed speed. This criticism is unfair.

That the D'Allest boilers are lighter than the Belleville boilers is also denied. It is asserted that, "counting water to the same level with steam pressure up to one hundred and eighty pounds per square inch," these boilers are practically of the same weight; beyond that, the weight is in favor of the Belleville.

The allegation that it is more practicable to force the D'Allest boilers than the Belleville is also denied. The French government does not require a greater consumption of coal per square foot of grate of the D'Allest boiler than is demanded of the Belleville.

The manufacturers, while stating that salt water can be, and has been, used "for considerable periods" without deteriorating the boilers or causing trouble from scale, do not, as implied by Chief Engineer Robison, think it the proper thing to use salt water in them.

It was alleged that the D'Allest boilers could be worked without automatic feed-regulators. Mr. Robison's critics allege that neither the D'Allest or any other water-tube boilers can be worked at sea "without automatic feeds, unless extraordinary pains and trouble be taken by those in attendance," and that these appliances are now being fitted both to water-tank and water-tube boilers in warships.

Mr. Robison's statement that, "while the D'Allest boilers use more coal than Scotch boilers for similar engines, ... the loss in coal has been with the Belleville boilers as much as forty-two per cent.," is stated to be "absolutely untrue." On the contrary, as good results in fuel consumption are claimed for the one as for the other.

The statement that reducing valves are required between any kind of tubulous boilers and the engine by the French government is admitted. It is explained that this is done solely to maintain steady pressure at the engines.

The conclusion expressed by Mr. Robison with reference to the Niclausse boiler is questioned on the ground of insufficient data. "The Friant is the only ship fitted with Niclausse boilers, and she has been in commission only six months," a period deemed too short to afford a basis of comparison of the relative cost of repairs.

As to the economy of the D'Allest boilers, it is asserted that this has not been the main reason for their adoption in France. The reasons are alleged to be of a commercial character, and not derived from a conviction of the engineering superiority of the D'Allest boilers.

The Serve tubes in the rows next the fire, instead of having been adopted on account of their greater durability, were tried, it is said, in the Belleville boilers without securing any appreciable advantage, and it is intimated that they were perforce adopted in the D'Allest boilers, because ordinary tubes next the fire would not stand the extreme heat.

Passing without remark what is said of the Belleville, D'Allest, and Niclausse boilers, as merely a matter of personal opinion between disputants, we come to still another denial of a statement by Mr. Robison, who said, in substance, that, while the Messageries Maritimes Company (one of the greatest of the French steamship lines) appeared to be fairly well satisfied with the performance of the Belleville boiler, it was still seeking for something more economical. He also asserted that for the last vessel designed for the company (the Ernest Simon) designs for Scotch boilers were prepared, and that, when he left France, there was still a question as to which type of boiler would be adopted.

This statement is pronounced grossly inaccurate, and it certainly appears that Chief Engineer Robison was misinformed in making it. The Ernest Simon was fitted with Belleville boilers, and has been some time in service. Since the first ship in which the company placed these boilers was fitted with them, sixty thousand horse power of the same boilers have been fitted in their ships, including those now going into the large mail steamers,—Chili, Peru, Cordhilera, and others. The Ortegal, not the Australien (as named by Mr. Robison), was the first ship of this great company supplied with the Belleville boilers.

The boilers are ten rows high, instead of twelve rows as asserted. It is denied that

feed water has "ever been admitted at the lower part of the boilers,"—even on the Australien, as Mr. Robison said *he has seen it*. It is denied that tubes break from water-hammering. Mr. Robison's assertion that the doors of a tube nest are never opened except to clean tubes is cited as proof that "*he never made a voyage in a vessel fitted with Belleville boilers*," or that, if he did, "*he never watched the management of the stoke-holds*."

In conclusion, it is charged that, with reference to the care and attention required, Mr. Robison has added exaggeration to his inaccuracy of statement. Thus this critique amounts to a general denial of facts alleged by Mr. Robison, and throws discredit both upon his ability as an observer and upon the impartiality of his conclusions.

The Coming Exhibition at Kiel.

FOLLOWING the great celebration of the opening of the North Sea Baltic canal of last year at Kiel, there will be this year—May to September inclusive—a unique naval and fishery exhibition. The enterprise is a private one, but *Engineering* (Dec. 6) asserts very positively that direct money-making is not its object. The main purposes are to present to the world the present importance of Kiel as a maritime center, further development of trade, and a demonstration to the world of the German advances in marine engineering.

There are to be three groups of exhibits, two of which are of special importance and interest to marine engineers, to wit: (A) navigation on the sea; (B) navigation on rivers; (C) fishery.

The groups and the classes in each are as follows:

A.—Navigation on the Sea.

Class I.—Sea and coasting sailing vessels,—models and drawings of modern and historical types.

Class II.—Paddle and screw steamers,—models and drawings.

Class III.—Motor boats of every description,—models and drawings.

Class IV.—Race cutters, sailing yachts, &c.,—models and drawings.

Class V.—Equipments for vessels of every description, such as masts, sails, rigging, anchors, chains, &c.

Class VI.—Engines, boilers, and fittings,—models and drawings. Furnaces, fire-boxes, feed-pumps, feed-heaters, &c.

Class VII.—Construction of vessels,—models and drawings. Arrangement of engines with regard to vibration. Water-tight compartments.

Class VIII.—Propellers,—models and drawings. Paddle wheels, screws, and other systems. Propelling by direct action of water, &c.

Class IX.—Coal and other fuels.

Class X.—Nautical instruments,—compasses, sextants, steering apparatus, alarm signals, sirens, ship lanterns, and electrical installations of all descriptions.

Class XI.—Lighthouses, lifeboats, saving of wrecked vessels, &c.

Class XII.—Food and food-preparing appliances, baking ovens, filter apparatus for drinking water, conserves of meat, ice machines, kitchens, &c.

Class XIII.—Cabin and saloon fittings, bedding, hammocks, lights, ventilators, refrigerators, &c.

Class XIV.—Equipment of the crew. Clothing, pantry, weapons, &c.

Class XV.—Naval hygiene,—ventilation, heating, pharmacy, surgery.

Class XVI.—Installations for maneuvering sails, for charging and discharging cargo,—cranes, winches, installations for coaling on sea.

Class XVII.—Materials used in ship construction,—wood, iron, steel, tinplate, armor-plate, copper, hemp, linen, cotton, canvas, rope, paint, &c.

Class XVIII.—Marine literature, marine paintings, charts, statistics; results of scientific naval research. Meteorological observations.

B.—Navigation on Rivers, &c.

Class XIX.—River steamers, tugs, ferry-boats, ice-breakers, appliances and vessels for raising wrecks,—models and drawings. Warehouse installations for charging and discharging cargo, &c.

Class XX.—Models and drawings of harbors, wharves, docks, pontoons, etc.

C.—Fishery.

Class XXI.—Sailing vessels and steam-

ers for sea-fishing,—models and drawings.

Class XXII.—Equipment, outfit, apparatus, and implements for whale and seal fishing, and for miscellaneous fishing.

Class XXIII.—Coast fisheries,—vessels, equipments, nets, and other apparatus for fishing.

Class XXIV.—River and lake fishing and appliances.

Class XXV.—Salted and preserved fishes for food, utilization of fish residues.

Class XXVI.—Fishing huts, dresses, and equipment.

German Shipbuilding.

ONE of the effects of the present strained relations between leading nations is the impetus given to naval construction. As never before, it has been impressed upon the minds of men that the most powerful navies are destined to shape future history, and every nation of importance is making an effort commensurate with its means to enlarge its navy to formidable proportions.

Thus, during the past year, the building of war-ships has had an unprecedented share in marine construction, and, while the number of vessels of this kind is multiplying, their cost is also constantly growing under the effort to increase their efficiency. Germany is a nation in which this tendency is particularly noticeable. *The Steamship* (English) for January says:

"Germany is following with extraordinary interest the present crisis in British shipbuilding, and has already profited to a considerable extent by it. It seems determined, at any cost, to develop its shipbuilding industry to the utmost extent. The committee of German iron and steel works recently held a meeting at Hanover, and they have drawn up resolutions asking the government to make reductions in railway freights for all shipbuilding material used in German shipbuilding yards, and also to make it compulsory that all material used in ships of war shall be of German manufacture.

THE ENGINEERING INDEX—1896.

Current Leading Articles on Marine Engineering in the American, English and British Colonial Marine and Engineering Journals—See Introductory.

*3030. The "Evoy Jumper-Stay" Compass. Ill. (Describes a new ship's compass, so rigged that it can be hoisted aloft out of reach of local influences, the needle locked in that position, and the compass lowered to the deck again for reading). Marine Eng-Dec. 1. 600 w.

†3031. Plan of the Madras Harbor (Full-page drawing, with explanatory note). Ind Engng-Nov. 9. 300 w.

*3048. The Performances of Ocean Steamships. Arthur J. Maginnis (Suggests and advocates the estimation of steamship performance from the single basis of coal consumption. The unit basis being 1 lb.). Steamship - Dec. 2500 w.

3065.—$1.25. Contract Trial of the United States Coast Line Battle Ship Indiana. Harry Hall (Full description of the machinery and tests, with infolding plates and tabulated results). Jour Am Soc of Nav Eng-Nov. 6500 w.

3066.—$1.25. The Steam-Yacht Yosemite. B. F. Isherwood (Tabulated data and results from notes and indicator diagrams taken during a trial of four consecutive runs, with tables of dimensions and description of machinery). Jour Am Soc of Nav Eng-Nov. 6500 w.

3067.—$1.25. Test of a Babcock and Wilcox Boiler to Determine its Evaporative Efficiency (Descriptions and tabulated results of test made under instructions from the bureau of steam engineering of the U. S. Navy Department, with plates showing construction of the boiler and arrangement of the same in the Plant steamer). Jour Am Soc of Nav Eng-Nov. 4200 w.

3068.—$1.25. Torpedo Boat Destroyers. John Isaac Thornycroft and Sydney Walker Barnaby (Reprinted from Pro. of Inst. of Civ. Eng. Paper both historical and technical, with plates). Jour Am Soc of Nav Eng-Nov. 9300 w.

3069.—$1.25. Experiments to Determine the Causes of Steam Pipe Explosions on Board German Naval Vessels. Translated by William Wachsmann (Full account of preparations for and manner of conducting the tests, with plates, results and conclusions. A valuable paper). Jour Am Soc of Nav Eng-Nov. 2300 w.

3070.—$1.25. Liquid Fuel for Naval Purposes. John R. Edwards (One of a series of lectures delivered at the Naval War College, Newport, R. I. A strong argument setting forth the great advantages of liquid fuel for marine use, and containing suggestions looking toward safety and efficiency in its application to this purpose). Jour Am Soc of Nav Eng-Nov. 7600 w.

3071.—$1.25. Trials of the Lake Steamships Zenith City and Victory. B. C. Bryan (Dimensions and account of test trials, with tabulated results). Jour Am Soc of Nav Eng-Nov. 4000 w.

3072.—$1.25. Ships (Dimensional data, etc., of ships of the United States and other countries). Jour Am Soc of Nav Eng - Nov.

We supply copies of these articles. See introductory.

13500 w.

3073.—$1.25. Merchant Steamers (Dimensional data, etc., of recent American and foreign merchant vessels). Jour Am Soc of Nav Eng-Nov. 3500 w.

3074.—$1.25. Yachts (Brief descriptions of recently built yachts). Jour Am Soc of Nav Eng-Nov. 1100 w.

*3100. The Torpedo-Boat Destroyer "Lightning" after Collision with a Barge. (Description, with illustrations, of damage to this boat caused by her collision with a barge). Engng-Dec. 6. 1100 w.

*3102. The Kiel Exhibition of 1896 (Gives a programme of this exhibition which will comprise exhibits in three groups—navigation on the sea, navigation on rivers, and fishery. The first of these groups contains eighteen classes of marine engineering exhibits; the second comprises two classes, and the third seven classes. The whole will form an unique exhibition). Engng-Dec. 6. 1200 w.

3152. The Fight of the U. S. Naval Engineer Corps (An editorial argument favoring the increase of authority of engineers in the U. S. Navy to a point commensurate with their responsibility). Am Mach-Dec. 19. 1000 w.

3166. Collisions Between Steamers and Whales. Ill. (A résumé of the occurrences of this kind which were on record prior to the collision of a steamer and whale, recently noticed in the daily and weekly press). Sci Am Sup-Dec. 21. 600 w.

*3194. The United States Cruiser "Minneapolis" (Illustrated description and contract trial data of this new cruiser. The official trial took place July 14, 1894). Engng-Dec. 13. 2000 w.

*3195. Shallow Draught Steamer for Russian War Service (Illustrated detailed description of a steamer, designed specially for service in shallow water on the Amu Darya River, and of which the official trials gave very satisfactory results). Engng-Dec. 13. 1200 w.

*3198. Water-Tube Boilers. Maudslay, Sons and Field (Review and criticism of a paper written by Asst. Eng. Robison, of the U. S. Navy, and published in the *Journal of the Am. Soc. of Naval Engs.* The paper purported to give results from personal observations in France, which results are disputed in this review, and the paper, as a whole, is severely criticised). Engng-Dec. 13. 4300 w.

*3204. The Thames Iron Works and Shipbuilding Company (A very complete illustrated and detailed description of one of the largest and most important shipbuilding and marine engineering works in the world). Eng, Lond-Dec. 13. 11000 w.

3267. Our Merchant Marine (The American shipping is characterized as our one bankrupt industry, but "protection" is alleged not to be the cause, the contrary is affirmed, and an argument favoring discriminating duties and taxes follows. This policy is advocated in full view of its enormous difficulties, among which the fact that no less than thirty-five treaties would have to be abrogated or modified is not the least obstacle). Sea-Dec. 26. 3800 w.

*3349. Hepburn and Stewart's Patent System of Plating (General illustrated description of a new system, for which many advantages are claimed). Eng's Gaz-Dec. 350 w.

*3350. Broken Eccentric Strap (An interesting narrative illustrating the danger of makeshifts, the pig-headedness of a ship's captain, the stupidity of a chief engineer, and the sagacity of a second engineer). Eng's Gaz-Dec. 500 w.

*3351. Machinery Rules (Editorial upon the divergencies in the requirements of the various bodies which approve engines and boilers for ships, and a review of a paper recently read by Mr. John Key, at a meeting of the British Assn. at Ipswich, in which a uniform factor of safety for boilers and machinery for ships is advocated). Eng's Gaz-Dec. 700 w.

†3364. War and Its Modern Instruments (A symposium in which William S. Aldrich treats of "Speed in American War-Ships." P. H. Colomb Discusses the "Test and Value of Speed in War-Ships"; S. B. Luce Discourses on "Naval Warfare Under Modern Conditions," and John K. Cree talks of "The Influence of the Air-Ship in War"). N Amer Rev-Jan. 14500 w.

3411. Submarine Boats. Ill. W. A. Dobson (An account of progress in submarine navigation from Bushnell's boat (1776) to the present). Cos-Jan. 3600 w.

*3447. The Year's Shipbuilding (An interesting retrospect of this industry during 1895, incidentally touching upon the advantages and disadvantages of water-tube boilers—questions that have been hotly debated during the last twelve months). Ind & Ir-Dec. 27. 3500 w.

*3474. Shipbuilding and Marine Engineering in 1895 (A summary of the industry for the year and a review of the present status of the trade, from which the outlook is considered hopeful). Engng-Dec. 27. 3600 w.

*3499. Marine Engineering and Shipbuilding in the year 1895 in the United Kingdom (Review of the industry for the past year and a glance at the present status). Eng's Gaz-Jan. 8000 w.

*3500. An Investigation in the Forces Tending to Produce Vibration in High Speed Engines (Conditions of inertia including both rotary and reciprocating parts with and without balance weights, and independent of, as well as combined with, the effect of steam under usual working conditions, are considered in these investigations, and the data arrived at experimentally are systematically presented). Eng's Gaz-Jan. 700 w.

*3536. The Pendulum Propeller. Ill. H. C. Vogt (An able exposition of principles of propulsion as exemplified in fishes, and a mathematical discussion of those principles). Steamship-Jan. 3800 w.

*3537. Water Ballast for Steamers and Sailing Ships. M. W. Aisbitt (A history of ballasting is given, followed by a practical consideration of water ballasting as applied in modern marine engineering). Steamship-Jan. 2700 w.

MECHANICAL ENGINEERING

Ethics for Draftsmen.

MR. ARCHIBOLD DENNY, in his presidential address at the Institute of Junior Engineers this year, said that the engineering firm to which he belongs had found it expedient to formulate the following rule, quoted from their general order book:

"As there is growing in our office a large amount of special and organized information procured and organized at considerable expense by us, it must be clearly understood by every member of our staff that we consider this information private, and to be used only in our service. Any member of our staff found copying or removing any of this special organized information will be considered to have acted against honor, and will, on our coming to know of his action, be immediately, and without further warning, expelled from our offices. To such a person we will decline to give either reference or character. We consider that the opportunities afforded to the members of our staff in their ordinary work, and for private study by our library, are sufficient to enable them to acquire a knowledge of all methods of working, by means of which, should they leave our service for that of some other firm, or to start on their own account, they can collect and organize information for their employers or for themselves. There is, therefore, no excuse for their acting against honor in the way we have now forbidden."

In an editorial review of Mr. Denny's address (which covered many other topics) *Engineering* (Nov. 22) says of this rule that it "is well known that Messrs. Denny have an experimental tank, as at Torquay, aad the experiments there made result in valuable data which are exclusively their property, and are not obtainable in any other private establishment. Such data are costly, and cannot be arrived at without the use of their expensive plant. To copy such data is in the highest degree dishonorable; but, further, objection is very properly taken in practically all establishments to any drawings being copied, and in this latter respect draftsmen do not so readily appreciate the ethics of the case. In the first case, comparatively little work is regarded as special, in the sense that it is too costly or too recondite for an ordinary firm to obtain it for themselves. Again, work, when completed, cannot be kept secret, as is so often supposed. An engine, a ship, or a mill is put to work, and as soon becomes the object of study by competitors. Even indifferent observation readily enables a man to sum up all the special points, and ingenuity is quickened in the direction of improvement.

"But clearly it is beyond discussion that the copying of drawings, either in the draftsman's own time or in his employer's, is an act of theft, unless it is done by permission. No man is justified in taking even a sketch out of the works, but this condition does not necessarily preclude the making of private records. For days the draftsman's brains are concentrated on the solution of some problem, and he only arrives at the conclusion by aid of prolonged thought and much toil. The results are incorporated in his design, and for a time, at least, they are impressed on his memory. The latter, however, is often a treacherous guardian, and the only safe method is to supplement it by memoranda and sketches of greater or less completeness. It will be conceded, we think, by all employers that it is the duty of a draftsman to be always educating himself in that which concerns the department of work in which he is personally engaged. He must watch, as far as possible, the result of his designs, and take note of their good and bad qualities. This year's mistakes must serve as the foundation of next year's successes. But this can only be done efficiently if they are exactly defined, qualitatively and quantitatively.'

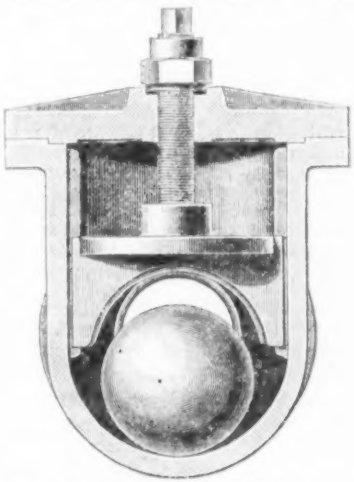
Now, to us it appears that the whole substance of a draftsman's duty in this particular is that he should take with him and consider as his property only that which he originates in his own time. There can be no wrong in a draftsman's taking away sketches of improved details invented or thus designed by him, or in his using them in future exigencies which he may meet; but, if set to delineate anything belonging to the firm employing him, that thing is not his, and he has no right to expose it to others or use it for his own or another's benefit. If a draftsman, after his day's work is over, sketches in his private room ideas which have occurred to him during the day, and which he wishes to retain as aids in future design, what right has his employer to either his ideas or his time? The fact is that employers are apt to assume the ideas of draftsmen to be their property, no matter how valuable they may be, and many a draftsman has been discharged for daring to make and patent an invention which, under threat of discharge, he would not assign to a covetous employer. It is difficult to draw hard and fast lines between honorable and dishonorable conduct. Circumstances and conscience must guide each man, and we much question either the need or the wisdom of such a rule as the one formulated by the Messrs. Denny.

New Isolating Valve for Steam Pipes.

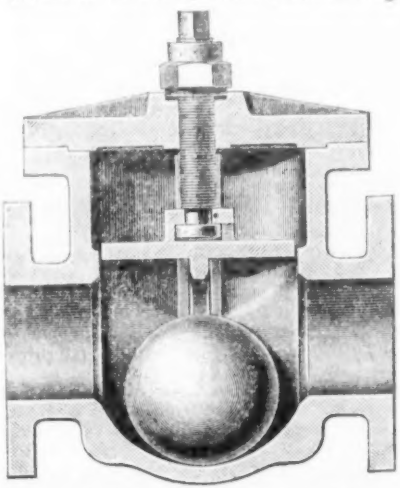
CURRENT events are emphasizing the need of a good isolating valve for steam pipes. Scarcely a month passes without the news of one or more men scalded to death by the bursting of pipes, and during December there were a number of fatal accidents from this cause. The most notable of these was on the steamship St. Paul. Another was in a New York theatre, and still another in a Brooklyn store.

The Practical Engineer (Dec. 6) described an isolating valve which has so much promise of efficiency that we have herewith reproduced the engravings, and made an abstract of the accompanying description.

When steam pipes burst, the greatest damage is generally done not so much by the explosion itself as by the immense volumes of steam and water which are poured forth by the broken pipe, threatening human life in the vicinity, the risk being aggravated where these accidents occur in confined situations. By careful super-



vision the risk of such accidents may be greatly minimized, but there are unavoidable cases where pipes may be subjected to strains which they were not originally calculated to stand, these strains being



set up by bending, or caused by the expansion of the pipes by heat.

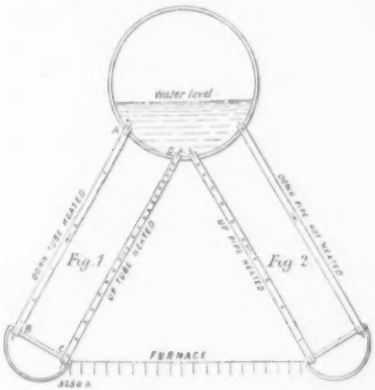
The valve shown is intended to automatically cut off steam communication from the boiler in case of such accidents. The valve contains a ball, which, in ordinary working, rests at the bottom of the casing. In the event of a pipe bursting, the sudden reduction of pressure on the outlet side of the valve will produce a rush of steam, which sweeps the ball along with it, and forces it against one or the other of the seatings provided for the ball at both outlets, enabling the valve to act either way.

The sensitiveness of the valve depends upon the area of the free passage past the ball, and an arrangement is provided for adjusting the area of this passage to allow the giving of any desired degree of sensitiveness to the valve. For this purpose a plate with a semi-circular opening, as shown in Fig. 2, is arranged across the passage in the center of the valve, and the distance between the ball and this plate can be regulated by turning the screwed spindle shown in the illustrations. The valve is proportioned so that in the highest position of this plate the ball would still close against the seating, in case of a complete fracture of the pipe.

This valve is accredited to Messrs. Schaffer and Bundenberg, well known to the engineering fraternity as the manufacturers of steam gages. The principle of the invention is sound, and, unless some practical difficulty comes in, it should be effective in closing off a steam pipe whenever the pressure is suddenly relieved by a rupture on the branch leading outward from the valve. To be of greatest service it ought to be placed as near the boiler as possible.

Circulation in Water-Tube Boilers.

SOME very interesting correspondence has recently appeared in *Engineering* (London) upon this important subject. Mr. Carlton L. Lambert, in a letter printed Dec. 6, supports a view previously expressed by Mr. Maxim, and says he has performed some experiments with U-tubes heated at the bend, and also heated on the down-legs of the tubes, the results of which he thinks amply prove that the heating of the down-leg gives even greater advantage than Mr. Maxim claimed for it. Assuming that both tubes are uniformly heated, and that the inner tube is heated twice as much as the outer one, he argues as follows: "In his explanation of the cause of these results Mr. Maxim does not go far enough, I think, if I interpret him rightly, and he understates the advantage derived from heating the down-tubes which can be deduced from his experiments. Mr.



Maxim says: 'It will be seen that whatever retardation is caused by these bubbles in the tubes which are taken in the water downwards is exactly counterbalanced by the volume which they add to the steam in the pipes which are taking the water and the steam upwards.' Now, I venture to suggest that the retardation caused by the bubbles actually existing in the down-tube at any time is more than counterbalanced by the buoyancy of the bubbles continuously being delivered from the down-tube into the up-tube, and that, assuming each tube is to be heated equally along its length, the resulting circulating force is greater (by an amount equal to the buoyancy of the bubbles actually existing in the down-tube) than it would be if the down-tube were not heated. This apparent anomaly may be explained by the fact that the number of bubbles per cubic inch (which I will call the bubble density) increases uniformly from nothing at the top of the down-tube to its maximum at the bottom, and that, while the up-tube is be-

ing continuously fed with water of this maximum bubble density, the down-tube, as a whole, has an opposing buoyancy due to only half this maximum."

"Now, when both tubes are exposed, as shown in Fig. 1, the water, entering the

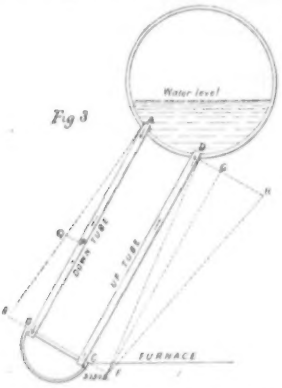


Fig 3

down-tube at *A*, has no bubbles, but by the time it reaches the end, *B*, it has, say, 10 bubbles per cubic inch. Thus at *C*, the bottom of the up-tube, and through its entire length, there will be 10 bubbles per cubic inch, due to the bubbles coming from the down-tube; and at *D*, the top of this tube, there will be these 10 bubbles per cubic inch plus an additional 20 due to the heating of the up-tube, or a total bubble density of 30. Thus the mean bubble density in the up-tube is 20, whereas in the down-tube it is 5. This gives a difference of 15, which is the measure of the circulating force.

"Now, when the down-tube is not heated, as assumed in Fig. 2, there are no bubbles at all in the down-tube and none at the bottom of the up-tube, while there are 20 per cubic inch at the top. This gives a mean bubble density of 10 in the up-tube, and the circulating force, therefore, is only 10 in this case, compared with 15 when the outer tube is heated, showing a gain of 5 in favor of heating the down tube. Or again, we may represent it graphically (Fig. 3). Let us represent the bubble density at any point, say *P*, by a line *P Q* set up perpendicular to the tube. Then, if *E B* is the bubble density at the down-tube (both tubes being exposed to the fire), the area of the triangle, *AEB*, may represent the total buoyancy in the down-tube.

"Now, in the up-tube the set of bubbles which has been supplied by the down-tube will be represented by the rectangle, *CFGD*, where $CF = EB$; and the other set, actually generated in the up-tube, will be represented by the triangle *FHG*, where $HG =$ (say) twice *EB*.

"Thus the total bubble buoyancy in the down-tube is the triangle *FHD*. This is, therefore, the resulting circulating force, whereas, if the outer tube had not been heated, it would have been only the triangle *FHG*. Thus there is a distinct gain derived from the heating of the down-tube, which is measured by the triangle *FDG*. Now, *FDG* is the same as *AEB*. Thus the gain is exactly equal to the buoyancy of the bubbles actually existing in the heated down-tube." He thinks the effect in a large working boiler would be even greater than that shown in the laboratory experiment.

Per contra, Mr. William Cross thinks Mr. Maxim's opinion as to the *modus* of circulation in boiler tubes of this class will have to undergo some modification. To sustain his position he gives results of experiments made by him with a model

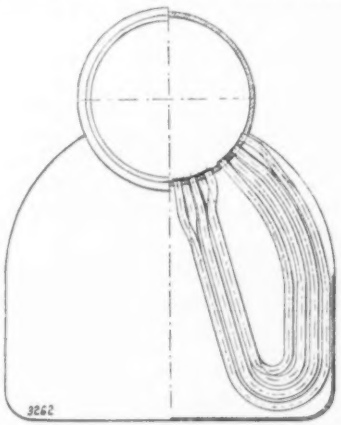


Fig. 4.

boiler, an end view of which is given in Fig. 4. He writes: "This model was made with glass ends to the water drum, so that the circulation could be observed, and was

heated by two powerful Bunsen burners. With any reasonable amount of heat the circulation was perfect, a mingled torrent of steam and water foaming out of each upcast leg, while bits of 'flue,' which were purposely put into the water, could be seen being dragged into the downcast legs; but, when an undue amount of heat was applied (to do which the furnace was nearly filled with Bunsen burners), steam bubbles began to come up the downcast legs, and the rate of evaporation fell off, showing that the circulation was falling. In another experiment a full-size tube, having the legs only six inches apart, was fixed in a special furnace built for the purpose. When the furnace was forced to the very utmost, the same thing occurred, and the tube became white-hot, though both ends were under water. I would add that the amount of heat required to effect this was out of all reason, and could not conceivably occur in an actual boiler. But it would appear to show that Mr. Maxim's idea as to circulation may require some modification, and that by applying sufficient heat it is possible to stop circulation altogether; and, if this can occur in a U-shaped tube, why not in a Yarrow, which is practically the same thing, the bend of the U being replaced by the bottom water-pocket?"

A New Metal—Tempered Wrought Iron.

AN account in *The Railway Review* (Dec. 14) of a new metal discovered and just brought to notice by a Mr. Dawson of Des Moines, Iowa, will attract attention, and perhaps be received with a justifiable doubt of its entire accuracy. No one, however, will suspect the journal named of any intention to exaggerate the facts relating to this alleged new discovery; those who doubt will do so on the ground of inherent improbability. Certain it is that, if these facts can be fully substantiated, the discovery (or invention, if that be the more appropriate name for it) is of an epoch-making character,—as much so as was the introduction of Bessemer steel.

Two names have been selected for this metal, neither of which appears to be entirely appropriate, and, doubtless, should its merits be established, it will be endowed by the mechanical engineering societies with a more characteristic cognomen. It is called "Damascus steel" and "tempered wrought iron." *The Railway Review* says:

"The most striking feature of the metal is that it may be cast direct from the crucible. It comes from the mold soft, nearly as much so as the wrought iron of which it is made. It can then be forged, welded, and tempered, and in each process it surpasses even the best wrought iron in ease and certainty of manipulation. There seems to be no danger of injuring the metal by burning in the forge. It is soft until tempered, and then it is as hard as the best tool steel. These statements, strange as they may seem, are based upon a series of interesting tests which were recently witnessed at the shops of the Chicago and Northwestern Railway in Chicago.

"The tests referred to consisted of forging a heavy lathe tool from a square bar about two inches square in section, which was heated, tempered, and put in a double driving wheel lathe to turn off a Midvale steel tire, upon which a heavy tool of Mushet steel had been at work. The forging showed the metal to be very tough and ductile under the hammer,—a heavy steam hammer,—and the piece did not fly to pieces at the first blow, as might have been expected from the fact that it was a casting. The tempering was done at a heat high enough to totally destroy steel, and this process was seen to be a simple one, as no drawing of the temper was necessary. The piece was heated very hot and plunged immediately into cold water, where it was allowed to remain until cool. The tool was ground and then put into the lathe, where it did, to all appearances, as good work as the Mushet tool, which it replaced. A severe test was given it, owing to the presence of several hard spots in the tire. A cold chisel was afterward forged from the same ingot, which stood well in chipping cast iron. The only part of the process which was not exhibited in this test was the melting and casting, but the appearance of the

sample left no room to doubt that it was cast."

Tests of this metal carried out at the shops of the Cleveland, Canton, and Southern railway are also described as giving equally surprising results, but these statements appear to rest solely upon the assertions of the inventor, and are not confirmed by other testimony. It is even asserted that a cold chisel made of this metal was successfully used to chip out a hard spot in the tire too refractory for lathe tools. It is further stated that "the metal is not hot-short, except when very nearly at the melting point, when, if struck by a steam hammer, it will break up, but can be welded up into a solid piece again. It welds readily in the electric welding machine, as shown by tests made by the Thompson Electric Welding Co., of Lynn, Mass. It welds at a lower temperature than steel. The metal takes an excellent polish, and has been worked successfully into knife blades. The tempering is done at a white heat just below 'sparkling,' and then the tool is dipped until the point is black. The tempered portion has a white appearance, when cool. The degree of hardness seems to follow the temperature to which the metal is heated before quenching, and the only difficulty found in getting men to work it properly is the fear of burning it, which leads them to quench from too low a temperature. There seems to be no danger whatever of burning, and the samples seen were heated in tempering to an extent which would have destroyed steel.

"The process is a simple one, consisting of placing good quality of wrought iron into crucibles, and heating to a pasty state. The tempering and fluxing element, the composition of which is a secret, is then added, and the further application of heat results in melting the mass. It is ready to be poured, after standing about fifteen minutes. Molds for this metal must be of such material as will stand the high heat of the pouring, and yet must be free from gas-producing elements. There seems to be no difficulty in getting castings entirely free from blow holes, and Mr. Dawson says that he is satisfied that it may be cast in intricate molds. He believes it to be applicable to any purpose to which wrought-iron forgings are now put, and in such work its property of being melted should lead to much saving of expense."

To such statements as these, not yet confirmed beyond the authority of Mr. Dawson, we can only apply the old newspaper expression, "important, if true." Nothing need be said by way of enlargement upon the possibilities of such a material, if it can really be added to the present resources of mechanical engineering; every practical mechanic is competent to judge for himself what advances can be made in machinery construction, if cast metal can be given the properties of the best tool steel.

The Modern Electric Traveling Crane.

A VERY good article, entitled "Notes on the Traveling Crane," by Chas. L. Griffin, appeared in *American Machinist* (Dec. 12). The details of construction are gone over, and the essentials of construction considered. As a sample of the character of this article, we quote the following relating to brakes.

"Much ingenuity has been expended upon the design of brakes to automatically check the descent of the load. The familiar Weston brake, though primarily invented for hand-crane service, has been modified and changed into so many different forms for power cranes that it is often a study to reveal its identity. Many a designer, after much mental labor, has brought out a new form of brake, only to find that he had the Weston device in principle, with the addition of some detail which was perhaps a loss rather than a gain. The differential strap brake is often used in some one of its many forms. A brake closely akin to this is operated on the principle of the multiplying friction of a band coiled on a drum. An electric brake is, perhaps, most generally used, in which case the strap or band is operated by a pair of solenoids. A combination of the electric brake and the mechanical brake has been used with much success, and constitutes the so-called duplex system. Much might be said in favor of this

system, for it not only secures practically absolute safety against dropping the load, but the action is prompt and perfectly smooth in lowering with heavy loads, when the pumping motion is so apt to occur with a single brake.

"When it is realized that by the reliable action of the brakes alone the load is sustained in mid-air, the freedom from accidents due to their failure best illustrates how well this troublesome problem has been met and solved. The action of a crane in service, handling, say, fifty tons, can but impress one with the tremendous responsibility thrown upon the breaking mechanism. The certainty and precision with which the heavy load is controlled by the brake is remarkable."

THE ENGINEERING INDEX—1896.

Current Leading Articles on Mechanical Engineering in the American, English and British Colonial Engineering and Mechanical Journals—See Introductory.

The Machine Shop.

3017. Notes on the Traveling Crane. Charles L. Griffin (Deals with electric traveling cranes, and is a very thorough, practical discussion covering all parts of the mechanism). Am Mach–Dec. 12. 3000 w.

3018. Some Mistakes of Mechanicians. W. F. Durfee. Ill. (An instructive and amusing article). Am Mach–Dec. 12. 1500 w.

3062. Segregation at Furnace and Foundry. Thomas D. West (Read before the Foundrymen's Asso. It is not the writer's intention to cover the question of segregation in cast iron, but to call up practical points which confront all in every day practice). Ir Tr Rev–Dec. 12. 3200 w.

3129. The Manufacture of Wire. Frederic A. C. Perrine (Descriptive of the various operations). Elec Engng–Dec. Serial. 1st part. 2200 w.

3149. Fitting Up a Foundry. Charles A. Hague (Describes and illustrates a foundry equipment recently fitted up with cupolas, pressure blowers, elevator, belted power outfit, and somewhat novel molding floor). Am Mach–Dec. 19. 3300 w.

3150. The Development of the Drop Hammer. Ill. C. E. Billings (Interesting and instructive, historically and technically. The first use of drop hammers is attributed to Col. Samuel Colt, in the year 1853. The essential features of a good drop hammer installation are separately treated). Am Mach–Dec. 19 1700 w.

3151. A Shaft Coupling. W. P. Anthony (Describes a very useful and simple coupling that has not been widely used though it appears to be superior to many now in use). Am Mach–Dec 19. 650 w.

*3205. Report on the Lille Experiments on the Comparative Efficiency of Ropes and Belts for the Transmission of Power (Abstract of a paper read before the Inst. of Mech. Engs., and translated by David. S. Copper). Eng, Lond–Dec. 13. 2500 w.

3281. Are Our Cupolas Built Right? John Pettigrew (Suggestions for improving shape of cupolas in vertical section, for practical reasons assigned). Foundry–Dec. 600 w.

3282. Hints Helpful to the Molder Who Does Not "Know How." E. H. Putnam (Causes and cure for scales; difficulty arising from shot iron; tempering sand; venting from cores; gating). Foundry–Dec. 1500 w.

3283. New Methods. H. Hansen (Possible application to repairing imperfect castings). Foundry–Dec. 1000 w.

3284. Aluminum, Silicon and Phosphorus in the Brass Foundry for Special Work. F. J. Davis (General review of the uses of these metals for the purpose named). Foundry–Dec. 900 w.

3398. Distribution of Power at the Works of Brown & Sharpe. Ill. (A good study in belts and belting practice). Ir Age–Jan. 2. 700 w.

3399. The Making of a Skate (Illustrated detailed description of processes, tools and methods). Ir Age–Jan. 2. 5500 w.

3438. Engine Bed and Cylinder Tools. Herman Landro (Illustrated description of an ingenious adaptation). Am Mach–Jan. 2. 1700 w.

3451. A Model Car Wheel Pattern (Illustrated description of a modern car-wheel pattern). Ir Tr Rev–Jan. 2. 400 w.

3452. The Growing Field of Compressed Air. Howard A. Pedrick (A discussion and description of applications of compressed air in machine shop and foundry practice, for the purpose of driving tools and implements). Ir Tr Rev–Jan. 2. 2700 w.

3485. Cutting Square Threaded Screws. Ill. Boyd Harriman (A thorough practical discussion of the different methods of making the so-called square threaded screws). Mach–Jan. 2400 w.

3488. The American Moulder and His Art. Simpson Bolland (An able review of progress in the art of moulding for casting objects in iron). Mach–Jan. 3200 w.

*3490. Defects in Iron Castings. D. Brown (The causes of defects are explained, and their remedies, in venting, coring, mixing metals for the cupola pouring are set forth). Ir & Steel Tr Rev–Dec. 27. 1800 w.

Steam Engineering.

3027. Efficiency of Boilers with Varying Rates of Fuel Combustion. R. C. Carpenter (Experimental data on this subject given and deductions made. Theoretical considerations occupy

much of the space devoted to the subject). Power –Dec. 2500 w.

3029. Water Tube Boilers (The first part gives a sketch of progress, and describes and illustrates the Pierpont serial water tube boiler). Lord's Mag–Dec. Serial. 1st part. 1800 w.

3075. Steam Plant at an Anthracite Breaker. H. G. Merrill (Illustrated description of the machinery at South Wilkes-Barre breaker of the L & W. B. Coal Co.) Safety V–Dec. 2000 w.

*3096. Steam Expansion Drop (A review and criticism of A. C. Elliot's paper upon Steam Expansion Drop read before the meeting of the British Asso., at Ipswich. The ground is taken that the clear enunciation of the limit of expansion made, in ordinary language, by Prof. Elliott, is obscured, rather than rendered clearer, by the manthematical analyses which follows and supports the statement). Engng–Dec. 6. Serial. 1st part, 3400 w.

*3103. Water-Tube Boilers. Carlton J. Lambert (Circulation in tubulous boilers of the Garrow type explained and illustrated). Engng–Dec. 6. 1000 w.

*3132. Good Regulation and the Shaft Governor. E. T. Adams (Suggestions toward securing better regulation, with practical hints as to the best method of working, and need of observing certain precautions). Sib Jour of Engng –Dec. 3300 w.

†3171. The Proportions of High Speed Engines. John H Barr (An attempt to derive empirical formulas from general experience in engine construction. An instructive and interesting paper). Trans Am Soc of Mech Eng–Dec. 2000 w.

†3172. Comparative Tests of Steam Boilers with Different Kinds of Coal. Charles E. Emery (Paper read at the N. Y. meeting of the A. S. M. E. A digest, with references to the information available in regard to a suggestion made at a previous meeting, by Mr. F. W. Dean, that boiler trials should be made on the basis of efficiency,—defined to be the ratio between the total which any given coal can generate by complete combustion, and part of it absorbed by the water heated and the steam generated). Trans Am Soc of Mech Eng–Dec. 10800 w.

3220. Proportioning of Heating Surfaces in Return-Tubular Boilers (General principles which underlie this feature of boiler design. Diversity of practice. The writer thinks the diameters of tubes should be kept down and that in no case is there need of exceeding an outside diameter of 3½ inches). Eng Rec–Dec. 21. 2000 w.

*3248. Remarks on Steam Pipes. J. T. Milton (Abstract of a paper read before the Inst. of Nav. Arch. A consideration of dangers and difficulties to be overcome with results of tests made by the Elmore Copper Co). Elect'n–Dec. 18. 2500 w.

3323. The Utilization of Anthracite Culm at Scranton, Penna. (Records the carrying out, with successful results, attempts to utilize culm as fuel for generating power. The success reached indicates that a vast quantity of power from culm piles may be realized). Eng News–Dec. 26. 1800 w.

*3346. Economic Tests of Boilers. Lavington E. Fletcher (Abstract of memorandum presented by the chief engineer at the annual meeting of the Manchester Steam Users' Asso. Description of boilers, and the character of the tests, with tabulated data from which it is concluded that they are not more economical than Lancashire boilers). Prac Eng–Dec. 20. 1000 w.

*3347. Corliss Engines. Fleming Fitzroy (Proportions of steam ports and valve seat diameters, with diagrams and formula). Prac Eng–Dec. 20. 1700 w.

*3348. On the Surface Condensing Plant at the Newcastle and District Company's Electric Light Works, Forth Banks, Newcastle-on-Tyne. William Cross (Read before the Northeast Coast Inst. of Engineers and Ship-builders. Illustrated detailed description of an interesting installment). Eng's Gaz–Dec. 1800 w.

*3354. Patterson's Suction Draught and Smoke Preventing Apparatus. Archibald Barr (Illustrated detailed description of the system, with tabulated results obtained by a series of experiments at the works of Paul & Co., Dumbarton, Eng). Engng–Dec. 20. 2800 w.

3432. Grate Areas and Heating Surfaces (Editorial, questioning some of the opinions entertained upon this subject, particularly the view that high rates of combustion are necessarily accompanied by imperfect combustion, although the fact is admitted that forcing the combustion in ordinary types of locomotive furnaces generally results in rapid diminution of efficiency). Ry Mas Mech–Jan. 1600 w.

3436. The Power Plant of the Farr Alpaca Company (Illustrated detailed description. Plant designed to supplement water power). Eng Rec–Jan. 4. 1800 w.

3439. Experiments on Steam Pipe Explosions (Condensed account of German experiments carried out at the Royal Dockyard, at Wilhelmshaven, with important deductions). Am Mach–Jan. 2. 1500 w.

3484. Boiler Reform. John J. Hogan (An able review of the causes which have retarded progress in boiler construction, mostly embraced in the phrase "disregard of natural laws," and a clear and concise enunciation of the laws which must be observed in approximating toward the ideal construction). Mach–Jan. 2500 w.

3486. The Steam Engine. F. F. Hemenway (The first part, after introductory matter, begins the discussion of heat, its nature, the unit of heat, the mechanical equivalent of heat, work and energy and combustion). Mach–Jan. Serial. 1st part. 2500 w.

†3515. Test of a 240 Horse-Power Babcock and Wilcox Boiler with Three Different Coals, for the Determination of Economy. Ill. St. George M. Anderson and Edmund J. Burke (The tabulated data derived from this well conducted test and presented in this article are exhaustive, interesting and instructive). Stevens In–Oct. 4000 w.

Miscellany.

*3009. Limits and Possibilities of the Gas

Engine. George Richmond (A consideration of the means suggested for increasing the efficiency of the gas engine). Eng Mag–Feb. 5000 w.

†3050. Tests of a Ten-Horse-Power De Laval Steam Turbine. Ill. William F. M. Goss (Account of a test conducted at the engineering laboratory of the Purdue University. Results tabulated). Trans Am Soc of Mech Eng–Dec. 1700 w.

†3051. Water Power—Its Generation and Transmission. Samuel Webber (Presented at the N. Y. meeting of the Am. Soc. of Mech. Eng. A critical examination of the various turbines in use and of their behavior under specified conditions, and modes of testing them). Trans Am Soc of Mech Eng–Dec. 5000 w.

†3052. Some Experiments with the Throttling Calorimeter. A. A. Goubert and E. H. Peabody (Presented at the N. Y. meeting of the Am. Soc. Mech. Eng. Describes methods, apparatus, and experiments, proving unreliability of the throttling calorimeter tests as commonly conducted). Trans Am Soc Mech Eng–Dec. 2000 w.

†3053. Effect of Temperature on Strength of Wrought Iron and Steel. R. C. Carpenter (An investigation conducted in the testing laboratory of Sibley College. Results tabulated). Trans Am Soc of Mech Eng–Dec. 800 w.

†3054. Recording Device for Testing Machine. G. W. Bissell (Describes and illustrates a new device for making an autographic record, as attached to an Olsen testing machine.) Trans Am Soc of Mech Eng–Dec. 600 w.

†3055. The Reliability of "Throttling Calorimeters." J. E. Denton (Presented at the N. Y. meeting. Gives description of method and apparatus, and describes an experimental investigation by which it is proved that without certain precautions, results may be entirely unreliable). Trans Am Soc of Mech Eng–Dec. 3700 w.

†3056. Experiments on the Friction of Screws. Ill. Albert Kingsbury (Presented at the N. Y. meeting. Describes method and apparatus and gives tabulated results with formula upon which calculations are based). Trans Am Soc Mech Eng–Dec. 1500 w.

†3057. Means Adopted for Saving Fuel in a Large Oil Refinery. Charles E. Emery (Presented at the N. Y. meeting. An account of economies secured by the installment of electrical transmission to outlying points to which the conveyance of steam from installed boilers was uneconomical on account of condensation in pipes, and by the additional installment of high-pressure, non-condensing engines operating power pumps). Trans Am Soc of Mech Eng–Dec. 1300 w.

3076. The New York Produce Exchange (Description of machinery and appliances in the building). Safety V–Dec. 1700 w.

3061. A Great Dredge (A description of a 3000 horse-power machine being built at Sparrow's Point, by the Maryland Steel Co., for improving the Mississippi River). Mfrs' Rec–Dec. 13. 1000 w.

*3063. Pilcher's Soaring Apparatus (Illustrates and describes the apparatus, explains its principles, and gives an account of the present state of development of apparatus and system). Prac Eng–Dec. 6. 1800 w.

*3064. Rope and Belt Transmission. V. Dubreuil (Abstract of a paper read before the Society of the Civil Engineers of France. Treats of diameters of pulleys and ropes; linear velocity; distance between pulleys; position of slack and tight strands; ratio of pulleys; kind of ropes; number of ropes; sectional area of ropes; wear of cables at work; balancing pulleys; shafting and bearings; shape of grooves; oiling ropes; friction of ropes and belts. A very practical discussion). Prac Eng–Dec. 6. 2300 w.

*3104. Locomotive for the Glasgow and South-Western Railway (Illustrated detailed description as exhibited by the specifications in the contract). Engng–Dec. 6. Serial. 1st part. 3000 w.

3108. Grinding Cards. Una (A very interesting description of special appliances, devices and methods not generally known). Bos Jour of Com–Dec. 14. 1500 w.

†3110. Comparative Test of a Compound Locomotive and a Simple Locomotive on the Central Railroad of New Jersey. Russell E. Taylor. Charles C. Kenyon, Edward D. Mathey (Tabulated details of construction, description of tests, and tabulated data resulting therefrom, with account of instruments employed, methods, and numerous diagrams). Stevens' Ind–July. 3000 w.

3127. Damascus Steel or Tempered Wrought Iron. Ill. (Describes a new metal which can be cast and yet, it is claimed, can be tempered and hardened as well as tool steel. The importance of this discovery, if confirmed, can scarcely be over-rated). Ry Rev–Dec. 14. 1600 w.

*3131. Suggestions on Boiler Testing. C. E. Emery (Dealing largely with the need of ascertaining the calorific value of different fuels). Sib Jour of Engng–Dec. 2500 w.

3153. The Chicago Motocycle Contest. H. L. A. (Full account of the race with illustrations of motocycles). Am Mach–Dec. 19. 3700 w.

3157. Power from Ocean Waves (A method of utilizing swells, near shores, to pump water in large quantity to heads available for use in driving water-wheels). Min & Sci Pr–Dec. 14. 400 w.

*3203. Wind Motors (First part treats of energy of winds and begins a history of windmills). Ind & Ir–Dec. 6. Serial. 1st part. 1500 w.

3285. Cincinnati's Great Bell. W. J. Tobin (Illustrated description of the moulding and casting of the largest bell ever yet made in the United States. The bell with its appendages weighs 43,000 lbs.) Foundry–Dec. 2000 w.

†3333. Address of Mr. J. T. Brooks (A general dissertation upon the way to attain highest excellence in locomotive engineering). Trav Eng Assn–Sept. 4000.

†3334. What Effect Has the Proper or Improper Manipulation of the Throttle, Cut-off and

Boiler Feed on the Coal Consumption (A short but interesting paper on the subject named, followed by a still more interesting discussion). Trav Eng Assn-Sept. 8000 w.

†3335. How Can the Traveling Engineer Assist in Preventing the Unnecessary Emission of Black Smoke (Brief but interesting paper with extended discussion). Trav Eng Assn-Sept. 4500 w.

†3336. In What Manner Can a Close Record be Kept of Condition of Engines, Amount of Work Performed and Manner of Doing It, Together with Manner in Which Work is Done by Engineer and Fireman, Which Will Serve as Record of Character and Qualification for Advancement of Men? (Report of committee, with discussion). Trav Eng's Assn-Sept. 2000 w.

†3337. What is the Smallest List of Tools, Arranged in the Order of Their Importance, that Traveling Engineers Would Recommend to be Carried on Engines, and What Now Carried Can Be Dispensed With? (Report of committee, with discussion). Trav Eng's Assn - Sept. 3800 w.

†3338. When Traveling Engineers are also Air-Brake Instructors How Can They Best Instruct and Examine the Engineer and Train men, without the Use of an Air-Brake Instruction Car, or Instruction Room? (Report of committee, with very interesting discussion). Trav Eng's Assn-Sept. 10000 w.

†3339. "The Art of Air Braking," from an Engineer's Standpoint, That is to Say, the Care and Manipulation of Engine Equipment (Report of committee, with interesting discussion). Trav Eng's Assn-Sept. 7700 w.

†3340. Could Not the Locomotive Service of the Country be Improved if the Furnishing of Feed Water and Coal was in the Hands of the Locomotive Department? (Report of committee. Gives summary of replies from twenty one members, to questions contained in a circular letter prepared by the committee, and relating to the subject named, with brief discussion). Trav Eng's Assn-Sept. 5000 w.

†3341. How Can Traveling Engineers Improve the Service in Rating Engines' Tonnage versus Number of Cars Hauled per Train? (Communication by P H. Stack, with discussion. Describes method of rating engines on the Union Pacific. Followed by a letter from General Inspector John H. Harris, also discussed at length, giving an account of the method of rating on the Denver and Rio Grande R. R.) Trav Eng's Assn-Sept. 5800 w.

†3342. How Can Traveling Engineers Reduce the Delays Caused by Hot Boxes and Bearings? (Communications from chairman, William Conger, Mr. I. H. Brown, and Mr. George T. Wells, presented in lieu of a report which was expected, with discussion. The letters and discussion are important and interesting). Trav Eng's Assn-Sept. 5000 w.

3421. Smoke Prevention and Smokeless Furnaces (Discussion of smokeless furnaces and kindred devices, waste due to smoke, hygienic questions, city ordinances relating to smoke, etc., with editorial comments on the desirability, practicability, and means of burning soft coal without producing smoke). Eng News-Jan. 2. 7000 w.

3427. Automatic Oiling (Illustrated description of the Wilson-Whiting-Davis system). R R Gaz-Jan. 3. 800 w.

3429 Tests of Oil Engines (Results of German tests of twenty-seven different engines, with tabulated data). R R Gaz-Jan. 3. 900 w.

3453. The New Tool of Transmission. Oberlin Smith (A general and interesting discussion of electricity as a means of transmitting energy, written in popular style). Ir Tr Rev-Jan. 2. 3200 w.

*3465. Designing a Flour Mill. W. L. Burner (Illustrated by diagrams showing judicious arrangement of machinery with detailed explanations). Am Miller-Jan. 700 w.

*3466. Mechanical Road Carriages. Ill. W. Worby Beaumont (A course of Cantor lectures on this subject. The first lecture is principally historical). Jour of Soc of Arts-Dec. 27. Serial. 1st part. 8000 w.

3483. High Duty Pumping Engines. Thomas Downs (A lecture given before the Robert Fulton Assn., Illinois N. A. S. E. A good study in this department of mechanical engineering, and an able discussion of the principles that should guide construction and design). Sta Eng-Jan. 2000 w.

3487. Modern Data on the Phenomena of Sliding Surfaces. John H. Cooper (These articles will presumably deal with all the phenomena of frictional contact. The first part discusses the friction of flat surfaces, both static and dynamic, and revives the old and oft debated question of the reason why a shaft can be more easily moved endwise in its bearings when revolving, than when at rest, but without throwing any new light upon this mysterious phenomena). Mach-Jan. Serial. 1st part. 2000 w.

3498. Wrought Iron Fly Wheels (Illustrates and describes important departures from ordinary fly-wheel construction, directed toward securing stronger and safer wheels, from designs by Mr. F. P. Sheldon for the Union R. R. Co., of Providence, R. I., and Mr. Edwin Reynolds, of the Edward P. Allis Co. of Milwaukee, Wis.). Power-Jan. 700 w.

3504. The Bennett Bisulphide of Carbon Engine. Ill. Lucius T. Stanley (Descriptive of an engine arrangement, designed by J. R. Bennett, of Philadelphia and being introduced by the Giant Power Co.). Elec Eng-Jan. 1. 1200 w.

†3509. Metallurgical and Other Features of Japanese Swords. Ill. Benjamin Smith Lyman (An exceedingly interesting and instructive account of Japanese forging and tempering by which excellent results are reached through simple methods, some of which appear to have been practically unknown to smiths in western countries). Jour Fr Inst-Jan. 3800 w.

3513. Some Tests of Air Compressors. Ill. A. E. Chodzko (Tests made by the military authorities on the dynamite guns of Fort Point, San Francisco). Jour of Elec-Dec 2800 w.

MINING & METALLURGY

Colorado Placer Mining.

In an article by Prof. Arthur Lakes, published in the *Colliery Engineer* (Dec.), we find the following description of a typical gold placer:

"First a foot or two of black turf in which there is no gold; below that a foot or two of clay with pebbles in it; then a few feet of sandy layers irregularly bedded in streaks, as if formed by eddies and currents. This also is commonly barren or poor. The remainder to bed rock, from thirty to fifty feet, is composed of subangular pebbles and boulders of all sizes, from that of a marble to masses a yard or more in diameter. These are cemented together by gravel and sand, which time, pressure, and solutions of lime and iron-oxid have cemented into a firm conglomerate, which can only be attacked by the pick or by the all-destroying giant nozzle. Such are the placer beds, for which we are indebted to glacier and stream.

"These banks are continuous down both sides of the stream for fourteen miles, but appear thickest on the east side, and especially near the village of Alma and opposite the outlet of the tributary cañon of Buckskin creek. This is the site of the oldest and largest placer workings in Colorado. The banks have been cut back for a long distance, presenting a line of vertical cliffs seventy feet in height for about half a mile in length, channelled by narrow ravines and gashes, as shown in our illustration (Fig. 3), by the inroads of the giants and the cutting back of the flume waterfalls. Some of these cuts are short gashes, not penetrating far into the hill; others lead through long narrow ravines into wide open amphitheaters, surrounded by channelled cliffs, whilst the center is occupied by tall piles of large boulders thrown out and piled up in the course of the work.

"Wending through these piles of *débris* may be seen the pathways of the old abandoned gravel-sluices, telling of the great work done and long since abandoned. It is into one of these amphitheaters where work is still actively going on that we enter through a cut and ravine on the southwest end of the hill. From this ravine issue two long snake-like gravel-sluices debouching onto the open river bottom by many radiating mouths and shorter branch sluices. The water rushes rapidly along the bottom of these sluices, and we can hear the big boulders rolling and bumping along over the riffles which line the bottom. We follow these sluices up the ravine for a thousand feet to where the ravine widens into a broad amphitheater two hundred feet wide by seventy feet deep. Here we see operations in full blast (Fig. 5).

"The first objects that strike our attention are four waterfalls descending the steep bank at the head of the amphitheater, each one cutting back rapidly a sharp, narrow ravine for itself from grass roots down to bed rock. Thus, these waterfalls, each fed by its own ditch on the bank above, cut the bank at the far end of the amphitheater into a series of parallel blocks or slices of ground. Against the sides of these blocks two giant nozzles direct their powerful columns of water with crumbling effect upon the loosely-cemented material, which rapidly fades before them, and mass after mass, undermined, rolls down into the refuse stream and thence into the gaping mouths of the gravel sluices. The giants, too, speed the boulders and sand on their way by adding their force to that of the refuse stream flowing from beneath the waterfalls. So, sand and gravel and boulders are washed into the gravel-sluices, the bottoms of which are lined with 'riffles' or short cross sections of the trunks of trees placed together like a lot of lozenges, or like a Nicholson block pavement. Both big and little boulders roll rapidly over this block pavement, and the gold, by its gravity, drops into the interstices between the blocks, and is retained there. Its reten-

tion and deposition are further assisted by quicksilver thrown in, which has an affinity for gold and collects the finer particles in its soft heavy mass.

"Whilst the boulders and gravel soon find their way to the dumping ground on the open river bed, the gold in its travel stops long before this point is reached. In the center of the amphitheater a tall derrick moves a long arm around over the area by the power of a ten-feet diameter Pelton wheel worked by water, and an undershot nozzle. The use of this derrick we see presently.

"One of the flumes is stopped, and its waterfall ceases; the giant nozzle is directed elsewhere; and the pathway of the stream becomes comparatively dry. Men gather into it and pick up the larger boulders, which are too large to pass conveniently through the gravel-sluice. Some of these are so large they have to be blasted. The long arm of the derrick swings around, and the boulders are placed in a large tray or stone boat suspended from the arm of the derrick and swung around to a convenient dumping ground on either side of the sluices. The larger boulders being removed, the gravel and finer pebbles become more exposed, and the nozzle is again brought to play on these, till at last bed-rock sandstone appears beneath, full of cracks and crevices, forming by its gentle dip and irregularities natural riffles and catching places for the gold.

"Now, the bed-rock cleaners go to work and dig up and shovel into the sluice the rotten surface of the sandstone to a depth of a foot or so, below which, experience has shown, no gold passes. They also probe the cracks with their knives, and pick out any stray nuggets that may be concealed there. Again, in the bed of the stream that descends from the flume, men

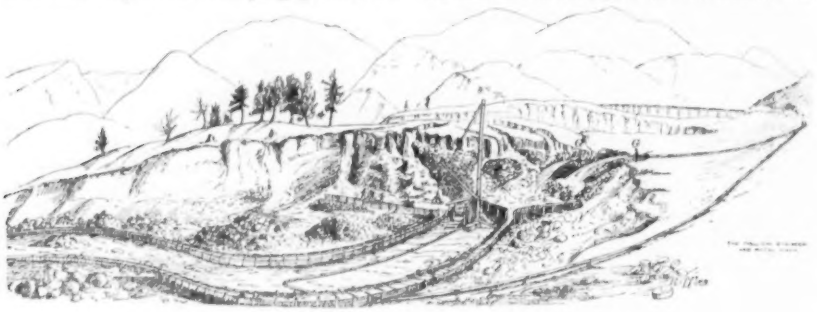


FIG. 5.—ALMA PLACER. *G, G*, GIANTS.

are at work with long-handled shovels 'ground sluicing,'—*i. e.*, helping along some of the boulders, so as to keep the water in as definite a channel as possible and prevent it from spreading."

Compressed Coal For Heating.

IN a meeting of the Society Versuchs- und Lehranstalt für Brauerei in Berlin, Herr Gaslich read a paper on coal briquettes. This was published in the *Oesterreichische Zeitschrift für Berg und Hüttenwesen*, and a translation of it appears in *The Colliery Guardian* (Dec. 6). The Saxony coals have such high percentages (50 to 60) of water that it is necessary to dry them before burning or compressing. Drying can be carried on to any considerable extent only where the most powerful presses are at work,—*i. e.*, at a pressure of about fifteen hundred atmospheres. Speaking of the marketing of such blocks of compressed coal, the author says:

"There is no product or manufactured article exhibiting such variations in price, or with which the public is so deceived, as compressed coal, both as regards quality and quantity. There are some works where only surface coal is manipulated, and only an inferior article is produced; in others again, half surface and half pit coal is used, whereby a better-quality product is turned out; and again, there are

some where only best pit coal is used, and consequently the best article, commanding a good price, is made. The latter have their own trade marks, which are, however, imitated as closely as possible by the manufacturers of inferior goods, so that it is very difficult for the consumer to find out which is the best. Another practice, opening a wide door for deception, is that of making blocks of different sizes,—some makes will go 35,000, while others are only 18,000, to the wagon load,—particularly as retailers always sell by number instead of by weight. The desire on the part of consumers is to have a clean, bright-looking block, for which they will pay a higher price, although these external indications have no connection with the quality or calorific value of the coal, but merely increase the cost of manufacture.

"For industrial purposes small cubical blocks are the best to use, being easier to shovel up and burning regularly in the furnace without falling to pieces. No concern need be had for smooth surface and clean edges, those being luxuries and unconnected with the quality. It is, however, well to see that the coal is dry and leaves but little dross or ash, and these properties are not discernible to the eye, but must be made the object of experimental determination. Heating experiments made with pressed coal showed that the production of 100 kilos of steam cost from 20 to 26 pfennige (8 pf. = one penny), while with Bohemian brown coal the cost was 30 pf., showing, at least under the conditions obtaining in Berlin, that an inferior pressed coal is appreciably cheaper than high-class Bohemian coal.

"In the discussion on the paper Dr Gronow remarked that, apparently, compressed coals are calculated to replace brown coal, and to some extent hard coal also. The calorific power of the former ranges from 4,500 to 6,000 units, while that of brown coal only varies between 4,500 and 5,000 units. The examination of forty samples of brown coal and eighty of briquettes resulted in an average heating value for the former of only 4,600 units, whereas the pressed coal averaged, 5,300, or some 15 per cent. higher. In practice however, these results do not seem to have been fully confirmed, for, though a saving in the amount of coal used has been effected, the difference does not correspond to what analysis leads one to expect. Two points of superiority possessed by the briquettes are the freedom from smoke, and the very regular fire produced. On the other hand, the high percentage of ash—up to 10 per cent.—tells against them, the brown coals having only from 3.3 to 6.6 per cent."

Much of our own coal which now goes to waste at the mines might be made marketable in the form of briquettes, and sold at a profit.

Indicator Veins.

PROSPECTORS soon learn to know the associations which are peculiar to the ore they hunt for. These are often of an unusual nature and constitute the "indications" which direct them in their subsequent explorations. The "indicator" which is described by Mr. T. A. Rickard in *The Engineering and Mining Journal* (Dec. 14) is a feature of the veins at Ballarat, Australia. "Ballarat East was distinguished for the particular richness of its old river channels or alluvial leads. It was many years before sufficient work had been done to suggest that the line of maximum richness was coincident with the occurrence, in the bedrock underneath, of certain quartz veins of peculiar character. In 1871 Mr. Morgan Llewellyn pointed out this feature. In Dec. 1888, Mr. E. J. Dunn described a similar occurrence in the neighboring district of Wedderburn.* In September 1893, the writer himself contributed a note† on the subject, and still more recently Mr. William Bradford read a short paper‡ before the Australasian Institute of Mining Engineers.

"The Indicator is essentially a thin bed

* "Report on the Country in the Neighborhood of Wedderburn and Rheola." Quarterly Report of the Mining Department of Victoria.

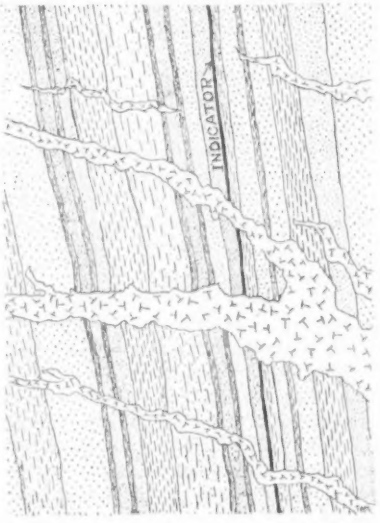
† "Certain Dissimilar Occurrences of Gold-Bearing Quartz." Proceedings of the Colorado Scientific Society, 1893.

‡ "The Indicator Feature in Some Gold Occurrences."

of dark slate of varying width, which in some parts of the region has undergone crushing and then becomes a clay, and in others is so mineralized as to be distinguished as a small seam of iron pyrite. At the end of the 700 ft. level in the New Normandy mine it was slightly over $\frac{1}{16}$ inch thick, and carried pyrite imbedded in crushed black slate. In a cross-cut nearby it became a small vein of quartz, an infrequent modification in its composition. In the adjoining mine—the Prince Regent—it was ¼ inch thick and carried both pyrite and black clay. Where black clay is replaced by quartz, the occurrence of rich ore is found by experience to be unlikely. The characteristic of the gold occurrence lies in the fact that the cross-veins or spurs of quartz which traverse the nearly vertical Silurian beds at a strong angle are valuable for their gold contents only in the close vicinity of the Indicator.

"The band of country enclosing the Indicator is ribboned,—that is to say, it consists of closely alternating thin beds of slate and sandstone of varying shades of gray. These, with the Indicator, which is one of them, are crossed and slightly dislocated by the quartz veins. The latter are irregular in their behavior and consist of simple white quartz (with only an insignificant percentage of iron pyrite), which is notably gold-bearing on either side of the indicator for a distance which differs at different places, but is usually comprised within the width of an ordinary drift.

"We may conceive this seam of black slate as a layer of fine silt or mud, full of minute remnants of vegetable life laid down upon the floor of the Silurian sea, subsequently covered by alternating layers of sand and silt, which, in the patient hands of time, became the sandstone and slate of to-day. The vegetable matter became carbonized, and, as in ordinary precipitation of gold in the chlorination process, became the agent compelling the subsequent deposition of gold from circulating solutions. The association of graphitic slates and shales with gold ore of notable richness is a matter which has come under the observations of many. They present a coincidence of evidence which, while it may be possible of explanation in some other way than that above suggested, must yet, in default of such stand as a very remarkable testimony



GEOLOGICAL SECTION SHOWING "INDICATOR."

upon the great subject of the origin of gold ores in veins."

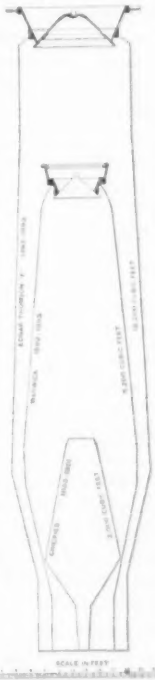
A glossary of stamp-milling terms follows the above description, giving the American term with the English and Australian equivalent.

Development of Iron Blast-Furnace Practice.

In an article, "Forty Years of Progress in the Pig-Iron Industry," in the *Iron Age* (Jan. 2), contributed by Mr. John Birkinbine, there are some interesting notes on early methods, from which we abstract as follows:

"In the year 1855 a majority of the blast furnaces of the country used charcoal, and were operated by cold blast driven into the furnace crucible by power supplied from near-by streams; but it was in this year that the quantity of pig iron made in the country by anthracite coal first exceeded that made with charcoal. Bituminous coal, however, did not outrank charcoal as a blast-furnace fuel until 1869.

The stacks which were supplied with mineral fuel, although generally of larger dimensions than those depending upon vegetable fuel, embodied similar constructive details. The furnaces were massive stone structures braced by iron beams and bars; the crucible was of small diameter, but of considerable height, terminating in flat boshes, the hearth, crucible and boshes being constructed of heavy sandstone blocks, neatly jointed. The in-wall, lined with soapstone or firebrick, terminated at a tunnel head-plate, through the opening of which the furnace gases escaped, except where these were in whole or in part diverted under boilers, and hot ovens placed at the level of the throat of the furnace. For one-half of the interval of time covered by the publication of the *Iron Age* the flames from gas ignited at the tunnel-heads of blast furnaces were beacons indicating at night the locations of these industries, and the melancholy wheeze of the leather-packed piston, slowly moving in wooden tubs, could be heard at many furnaces. The iron, as it was liquefied, was collected in and tapped from a fore hearth, and the cinder withdrawn under a tymp and weight plate, the latter being occasionally lifted for the purpose of working the furnace with bars and removing with large shovels unconsumed fuel, imperfectly reduced ore, &c. Furnaces 45 to 60 feet in height, with boshes 12 to 14 feet in diameter, were noteworthy as large plants, and an average output of twenty-five tons of pig metal per day was considered an excellent work for such a furnace. The chemist was practically unknown around iron works, the iron produced being sold by fracture and gaged as to quality by its behavior under the rolls or hammer or in the foundry. These qualities were designated by the terms 'cold short,' 'red short,' 'neutral,' &c., and the grade by numbers of 'foundry' or 'forge' iron.



"The three furnaces selected as illustrative are in Pennsylvania. The larger one, in Allegheny County, Pa., used coke as fuel; the two which are smaller are located in the eastern part of the State, and were constructed to use anthracite coal. The Chickies blast furnace, near Columbia, Pa., was originally built in 1846, and in 1855 had a bosh diameter of 10 feet 10 inches, and a height of 40 feet, making in the following six years five blasts. In 1861 the stack was made 5 feet higher, and in two campaigns of 44 and 60 months respectively 1.67 tons of anthracite and 2.19 tons of ore were required per ton of pig metal. Subsequently the furnace was rebuilt to larger size."

The Warwick furnace of Pottstown, Pa., was built in 1876 and rebuilt in 1886, and hot-blast stoves, cooling plates, etc., were added in 1892, at which time but 2250 to 2327 lbs. of fuel were required per ton of pig iron, the ores averaging 61 to 63 per cent. of iron. The average weekly output at the end of 1894 was 976 gross tons, while as high as 1,100 tons per week were produced during 1895. These are large figures compared with its first year's run, where but 189.5 gross tons were produced per week.

At Braddock, Pa., the nine Edgar Thompson furnaces have been doing excellent work, having a total production in sixteen years of six million tons of pig iron. "The fuel and average daily product showed great improvement, until in 1889 furnace F had an average coke consumption of but 1,920 pounds per ton of iron, 310 tons being the daily output. In the latter part of 1894 the eight furnaces which were running on Bessemer metal averaged 11,000 tons per month, the fuel consumption being between 1,900 and 1,950 pounds, including allowances for loss and waste, which for a month or more has fallen below 1,760 pounds."

"Our pig-iron industry has not developed by multiplying plants, but by improved practice. The large stables, which were a necessity for nearly every blast furnace in 1855 to accommodate a hundred or more draft animals, have been supplanted by moderate-sized locomotive houses; the flaming tunnel-head has been extinguished, and gases utilized to heat the blast and supply steam; the bridge-house connecting the tunnel-head to a near-by bank has been displaced by steam elevators; the small wooden casting-houses have grown into large iron and brick structures. The blast of 1,000 to 3,000 cubic feet per minute delivered at from 1-2 to 5 pounds pressure and from atmospheric temperature of from 600 degrees to 900 degrees F. has been intensified, until it is now supplied at from 1,000 to 1,500 degrees F., under pressure of from 10 to 15 pounds per square inch and in volumes exceeding 30,000 cubic feet per minute to one furnace stack. The cinder, instead of being dragged from the tymp by long hooks in the keeper's hands, flows into ladle cars, which are hauled to the dump by locomotives, and at a large steel works much of the iron made is similarly handled in the liquid state. The ore and flux, which were prepared by hand hammer or thrown into the furnace in great lumps, are now reduced in size by rock breakers, and in all parts of the furnace plant and in transporting materials labor is economized, until to-day, in making a given quantity of pig iron, but one-fifth the labor is necessary that was required forty years ago."

Coaldust Fuel.

In a paper before the Prussian Union of Boiler Inspectors a paper was read by Mr. C. Schneider which is abstracted by *The Colliery Guardian* (Dec. 20) as follows: "In June 1894, three trials were made of the Schwartzkopf system of utilizing powdered coal as a boiler fuel. The boiler used was two-flued, the coaldust apparatus being fixed in front of one flue, the other being divided longitudinally by a partition, so that the hot gases traversed the length of the boiler three times before passing into the chimney. It rested on three cast iron stools, had no special setting, and therefore the loss of heat by conduction and radiation was unusually high. The results of the experiment did not, therefore give a sufficiently clear measure of the effectiveness of the fuel-supply apparatus. Three kinds of coaldust were used of calorific values 7,323, 7,861, and 4,960 heat units respectively. The heats utilized were 60.23 per cent., 59.10 per cent., and 59.66 per cent. respectively. The temperature of the chimney gases and the percentage of carbonic acid were observed at intervals. The average temperature during the three trials were 530° C., 522° C., and 478° C., respectively. The chimney losses were 19.92 per cent., 18.66 per cent., and 22.01 per cent., respectively, of the total heat of the fuel; the radiation losses were 19.88 per cent., 22.25 per cent., and 18.33 per cent. respectively." The author gives the advantage of coaldust fuel as: the most perfect combustion, smokelessness, little labor required, independence as to kind of fuel, adaptability, preservation of boiler, and ease in removing fire; the disadvantages are grinding the coal into dust, necessity of mechanical feed, ashes in tubes of boilers, and dust in boiler house.

THE ENGINEERING INDEX—1896.

Current Leading Articles on Mining and Metallurgy in the American, English and British Colonial Mining and Engineering Journals—See Introductory.

Metallurgy.

3047. Copper Refining by Electricity. H. C. Garneau (Description of process which is said to be both cheap and rapid). Elec Age–Dec. 14. 1200 w.

3085. Improved Method of Handling Pulp in Silver Mills. L. W. Tatum (Description of a method of testing a plant showing how the capacity was increased, the losses reduced and the expenses cut down by intelligent arrangement). Eng & Min Jour–Dec. 14. 1000 w.

*3092. Coal Washing and Coke Making Plant. Ill. (A coal washer whose principal feature is a settling chamber which allows the fine coal to settle and the water to be used again immediately. The banks of coke ovens in connection are of the Coppée type). Eng, Lond–Dec. 6. 1600 w.

We supply copies of these articles. See Introductory.

*3105. The Employment of Compressed Coal for Heating Purposes (Translated from *Oesterreichische Zeitschrift für Berg-und Hüttenwesen*. A description with statement of advantages and disadvantages of coal briquettes. Forty samples of brown coal gave a heating value of 4600 units, while briquettes gave 5300, or 15% higher. The evaporative value is, however, less). Col Guard–Dec. 6. 1000 w.

3124. Value of Raw Materials in Iron Making. William B. Phillips (Read before the Alabama Industrial and Scientific Society. Many interesting points in furnace practice are brought out. Eleven irons are given, with the burden required in each case). Tradesman–Dec. 15. 1900 w.

3125. Notes on Improved Methods of Coking. John S. Kennedy (Description of the beehive, Otto-Hoffman, and Semet-Solvay Coke ovens, with a statement of the qualifications of a good coke for metallurgical purposes). Tradesman–Dec. 15. Serial. 1st part. 3000 w.

3158. The Basic Blow. F. E. Thompson (The conditions and method of working are ably described, much data derived from practice being given; the regulation of temperature is fully treated). Ir Age–Dec 19. 3400 w.

3159. Fusibility of Bottom Sand. Charles Ferry (The results of chemical and physical examinations of refractory sands intended for furnace hearth bottoms. The author advocates chemical tests). Ir Age–Dec. 19. 2200 w.

3180. The Chemistry of the Cyanide Process —Is Zinc Potassium Cyanide a Solvent for Gold? J. S. C. Wells (The writer concludes from his argument that zinc potassium cyanide is a solvent for gold, but is valueless in the presence of free potassium cyanide, hence of no benefit in the cyanide process). Eng & Min Jour–Dec. 21. 1000 w.

3181. Pan Versus Tina Amalgamation (Additions to and criticism of a paper by Mr. Pazos on the use of copper in amalgamation. The author gives the effect produced by substituting iron for copper at the Bolivian silver mills). Eng & Min Jour–Dec. 21. 1500 w.

†3185. Temperature of Gases from Lead Furnaces. Malvern W. Ills (The method used in the temperature determinations is fully explained. The author says the separation of slag from matte is more perfect at higher temperatures). Sch of Mines' Quar–Nov. 2500 w.

*3202. The History of Mond's Nickel Extraction Process. Ludwig Mond (Abstract of a paper read before the N. Y. Society of Chemical Industry. History of the discovery of nickel carbonyl, and its application to the Mond process). Ind & Ir–Dec. 6. 1900 w.

*3209. Present Position of Aluminum (Brief outline of the growth of the industry, with a table giving the price at various periods. In 1856 it was £18 per lb.; in 1895 it was 1s. 6d. per lb.). Ind & Ir–Dec. 13. 900 w.

3240. Ideal Steel. B. F. Spalding (The qualities necessary to make a steel ideal are enumerated). Age of St–Dec. 21. 1800 w.

3286. Reduction Works of the Compania Huanchaca de Bolivia. K. F. L. (Description of a large silver reduction plant in the interior of Bolivia). Eng & Min Jour–Dec. 28. 2400 w.

3290. Hainsworth's Cylindrical Casting Ladle (Consists of a horizontal cylinder revolving on runnions, and is applied to Bessemer practice. The accompanying drawings fully explain construction and operation). Ir Age–Dec. 26. 3300 w.

*3301. Coal-dust Fuel. C. Schneider (On the use of coal dust in a boiler as fuel. The heating effect was 78% of the calorific capacity of the fuel). Col Guard–Dec. 20. 900 w.

3384. The Copper Industry of the United States. James Douglas (The article contains a résumé of the early history of copper production and its subsequent development. A large amount of valuable information is given). Ir Age–Jan. 2. 4500 w.

3386. The Lead Industry of the United States. Edward A. Caswell (A general review of the industry with conditions which have influenced the trade). Ir Age–Jan. 2. 4000 w.

3387. The Nashua Open Hearth Furnace of 1867. Ill. S. T. Wellman (An early steel melting furnace built at South Boston. Various sections are given which fully illustrate the construction). Ir Age–Jan. 2. 600 w.

3388. Development of American Wire Rod Rolling. William Garrett (An interesting history of the competition with English rods and wire, and an account of how the early difficulties in manufacture were overcome. The article ends by giving some valuable statistics). Ir Age–Jan. 2. 6000 w.

3389. Forty Years of Progress in the Pig Iron Industry. John Birkinbine (A large part of the article is devoted to the development of blast furnaces, giving diagrams of the types of 1855, 1890, and 1895.) 5000 w.

3390. Early Iron Making in Chicago. O. W. Potter (History of the mills from 1857 to the present). Ir Age–Jan. 2. 2200 w.

3391. The Iron Industry of the Lehigh Valley. Oliver Williams (Interesting reminiscences of this great iron producing region). Ir Age–Jan 2. 1800 w

3393. Steel Rails in the United States. Robert W. Hunt (Early history and reminiscences of Bessemer practice). Ir Age–Jan. 2. 2000 w.

3394. Steel Rails in 1869 (Reprinted from the Iron Age, Nov. 11, 1869, when steel rails were being first extensively introduced). Ir Age–Jan. 2. 3500 w.

3396. The Mines and Manufactures of Pennsylvania in 1866 (Extracts from a series of articles published in *The Iron Age* in 1866, descriptive of the observations made during an excursion, accompanying David A. Wells, special commissioner of Internal Revenue). Ir Age–Jan. 2. 2400 w.

3397. The American Iron Trade Since 1870 (A valuable epitome of progress). Ir Age–Jan. 2. 9500 w.

3417. Copper Refining by Electricity. H. C. Garneau (A concise description including the

recovery of gold and silver). Min & Sci Pr-Dec. 28. 900 w.

*3442. Diffusion and Segregation of Metalloids at the Furnace and Foundry, and Methods for Lessening Their Final Evil Effects. T. D. West (Abstract of a paper read at the meeting of the Foundrymen's Assn. (U. S. A.) The variation in composition is ably discussed). Ind & Ir-Dec. 27. 3000 w.

*3445. Sodium in Aluminium (A paper read before the Academie des Sciences in Paris, by M. Moissan on the effects of various metals when associated with aluminium, stating that it is rapidly converted into alumina, especially in the presence of water). Ind & Ir-Dec. 27. 1300 w.

3448. Iron Works of the Mahoning Valley (Illustrated description). Ir Tr Rev-Jan. 2. 2200 w.

3454. Most Modern of Charcoal Furnaces. Ill. (Complete description of furnace, stoves, dust catcher, charcoal ovens, well illustrated by sections, plans and views. The furnace is 60 ft. high with 12 ft. bosh). Ir Tr Rev-Jan. 2. 1900 w.

*3477. The Reduction of Manganese in Blast Furnaces. Franz Büttgenbach (Translated from *La Revue Universelle des Mines, de la Metallurgie, &c.* Estimation of the quantity of manganese that will enter into pig iron). Col Guard -Dec. 27. 2300 w.

*3489. The Training of Metallurgists. A. H. Sexton (Abstract of a presidential address delivered before the West of Scotland Iron and Steel Inst., Glasgow. A very interesting and instructive discussion on the systems of education in use, and the qualifications that have to be met). Ir & Coal Tr Rev-Dec. 27. 5000 w.

†3511. Structural Steel. James Christie (A popular lecture in which the history, process of manufacture, testing, necessary properties, etc., are briefly reviewed). Jour Fr Inst-Jan. 4500 w.

3521. Proposed Standard Structural Shapes (Report of a committee of the Assn. Am. Steel Mfrs. giving drawing of sections of I beams and channels, the general formulæ for weight, strength, and moment of inertia of such sections, and tables of different weights and dimensions). Ir Age-Jan. 9. 450 w.

3528. The Southern Pig Iron Market (A commercial paper giving the production of the southern states, the distribution of shipments of the Tennessee Coal and Iron Co., and suggestions toward improving the market). R R Gaz -Dec. 13. 1200 w.

3538. Manufacture of Carborundum. Ill. (An excellent description of the method and furnace employed in the production of this new abrasive. It is a carbide of silicon produced in an electric furnace, 16×6×5 ft. in size, working at 6000 to 7000 degrees temperature). Min & Sci Pr-Jan. 4. 1500 w.

3539. The Fauvel Process (Address of the inventor before the stockholders—the process consists in a gradual roasting up to 1600°, then plunging into water and treated with mercury). Min & Sci Pr-Jan. 4. 1200 w.

Mining.

*3005. Gold Mining in the Southern States. H. B. C. Nitze (A statistical geological review of the gold ore deposits in the southern states, and of the methods of working them). Eng Mag-Feb. 4500 w.

3031. Routes to the Yukon (Discussion of the various possible routes to the gold placers along the Yukon River, showing their relative merits). Min Ind & Rev-Dec. 5. 1000 w.

*3032. Prospecting for Placer Gold. Arthur Lakes (A description of Alma Placer, South Park, Colo. The method of economically handling large quantities of gold-bearing soil in this typical placer is treated in a detailed manner and illustrated by sketches). Col Eng-Dec. 5000 w.

*3033. Gold and Silver Mining. Ill. Francis T. Freeland (Timbering for precious metal mines in Colorado. The methods of working and conditions which influence the methods of timbering). Col Eng-Dec. Serial. 1st part. 1800 w.

*3034. Iron Ore Mining. H. H. Stoek (The mining and washing of iron ores at Scotia, Penna). Col Eng-Dec. 3000 w.

*3035. Electric Plant at Essen Mines (A description of the largest electric mining plant in America. It is located at the Essen Mines, at Federal, Pa.). Col Eng-Dec. 2400 w.

3036. Colorado's Golden Era (A short general description of the principal properties from the *N. Y. Sun*). Sci Am Sup-Dec. 14. 3300 w.

3060. Gasoline Engines in Mines. Ill. (Brief description of gasoline engine hoisting and pumping installations in California). Min & Sci Pr-Dec. 7. 900 w.

3086. The Indicator Veins, Ballarat, Australia. T. A. Rickard (A valuable article. The indicator is a thin bed of decomposed slate with pyrite, lying parallel to the gold bearing strata. A glossary of stamp mill terms used in America, giving the English and Australian equivalent, accompanies the article). Eng & Min Jour-Dec. 14. 2000 w.

*3112. The First Discoverer of Gold in New Zealand (An entertaining article from the Auckland "Weekly News" giving a history of the early prospecting in New Zealand). Aust Min Stand-Nov. 16. 3300 w.

*3113. Mineral Bearing Veins (A general article treated in an elementary manner). Aust Min Stand-Nov. 16. 2200 w.

*3154. Electric Rock Drills. Ill. (Description of an electric percussion rock drill in actual operation). Stone-Dec. 1400 w.

*3155. An Incline Quarry Railway. Ill. (A 45° incline, 300 ft. long, into the side of the mountain at Rutland, Vt., for hoisting marble). Stone-Dec. 500 w.

3178. Dry and Wet Crushing of Gold Ore (History of the substitution of wet for dry crushing and showing the tendency back to dry

crushing by rolls, followed by a leaching process for extraction of the gold). W Min Wld–Dec. 7. 2000 w.

3182. The Minerals of the Sierra de Uspallata, Argentine Republic. G. Ave-Lallemant (Treating of the geology and mineralogy of the ores mined). Eng & Min Jour–Dec. 21. 850 w.

3183. Steam Shovel and Derrick Placer Mining in Idaho. John B. Hastings (Illustrated description). Eng & Min Jour–Dec. 21. 800 w.

*3199. The Limitation or Localization of Colliery Explosions. James Ashworth (Discussion with examples of the apparent preference of some areas to others in mine explosions). Col Guard–Dec. 13. 2500 w.

*3200. Mines and Works of the Commentry-Fourchambault Company (From a descriptive notice prepared for the International Jury at the Bordeaux Exhibition. The various collieries are briefly described. The iron and steel works, dating from 1825, employ 2700 men, while the mines have 6500 employees. The yearly output is 1,000,000 tons of coal, coke, and briquettes; 30,000 tons of pig iron, and 40,000 tons of finished iron and steel). Col Guard–Dec. 13. 2500 w.

*3201. Shaft Sinking by Congelation. Messrs. Saclier and Waymel (Abstract of a paper prepared by the Inst. of Civ. Engs., from the *Bulletin de la Société de l'Industrie Minérale*. Itemized cost statements are given. The paper contains much of value). Col Guard–Dec. 13. 3000 w.

*3216. Dry Crushing Experiments. Franklin White (Detail results of tests of gold ores for the purpose of recovering the gold in the tailings and sluices. Wet crushing consisted in crushing, amalgamating, concentrating, cyaniding of sands, of sluices, and retreatment of concentrate; the dry process would require crushing, cyaniding, concentration, possibly amalgamation on small scale, and treatment of concentrates). Aust Min Stand–Nov. 2. 2000 w.

3273. Ancient Quartz Mining. I. B. Storch (Description of some ancient (200 B. C.) methods of mining gold). Min & Sci Pr–Dec. 21. 500 w.

*3275. The Useful Minerals of Tasmania. A. Montgomery (The minerals are considered with regard to their geological associations, and their economic importance). Aust Min Stand–Nov. 23. Serial. 1st part. 3400 w.

*3276. The Rand in 1886. Fred Alexander (Reminiscences of the Early Gold Discoveries in South Africa). Aust Min Stand–Nov. 23. 2200 w.

3287. Coal in Colombia (Short description of the various localities where coal is found). Eng & Min Jour–Dec. 28. 1000 w.

3288. The Zinc Mines at Aurora, Missouri. Ill. H. K. Landis (The article contains the production of all ores since 1890, the prices since 1886, a typical set of mining rules, geological sections, and two views of plants). Eng & Min Jour–Dec. 28. 1100 w.

3289. Coal in Western North Carolina. William B. Phillips (An unexpected discovery of coal and mineral oil. The find is of considerable geological interest). Eng & Min Jour–Dec. 28. 1400 w.

*3300. Measuring the Pressure of Gas in Coal. M. A. Simon (Abstracted from the *Annales des Mines*. Experiments made in a French colliery to determine under what pressure the gas was held enclosed by the coal. The maximum pressure was observed at the bottom of a bore-hole 39 ft. deep, as being 105 lbs. per sq. in.) Col Guard–Dec. 20. 2600 w.

*3302. Kootenay Mines of British Columbia. From *Imperial Institute Journal* (An interesting description of this gold producing region). Col Guard–Dec. 20. 1100 w.

*3303. The Employment of Regular Curves in Driving Headings. Ill. P. Krassnig (Instructions for laying out regular curves without a transit). Col Guard–Dec. 20. 500 w.

*3317. Temporary and Permanent Repairs to a Winding Shaft. Ill. (The trouble was caused by a movement of the strata forcing in the masonry lining of the shaft. Piles were driven into the loose material and the surface held in place by cross timbers, until the wrought iron tubing lining, backed by concrete, could be inserted). Eng, Lond–Dec. 20. 1100 w.

*3320. A New Coal Washer. Ill (A new form of coal jig used in France). Eng, Lond–Dec. 20. 1800 w.

3385. Copper Mining at Lake Superior. John Stanton (A general description). Ir Age–Jan. 2. 3000 w.

3406. Amendments to the Nova Scotia Mines Act (A report before the Mining Society making various recommendations for the consideration of the law makers. Mining education was discussed and the nature of the instruction specified). Can Min Rev–Dec. 9000 w.

3407. A Mineralized Zone in Nova Scotia. Henry S. Poole (A compilation of notes on the various ore-bearing localities of Nova Scotia, with references and map). Can Min Rev–Dec. 4500 w.

3408. The Capacities of Coal Cutting Machines. W. Blakemore (An interesting comparison of the work done by three coal cutting machines at the Dominion, No. 1 Mine, Nova Scotia, with discussion). Can Min Rev–Dec. 3000 w.

3449. Lake Superior Iron Ranges. John Birkinbine (A general article on the conditions of working). Ir Tr Rev–Jan. 2. 2800 w.

3455. The Mineral Interests of the South in 1895. Wm. M. Brewer (The rare minerals—coal, iron ore, building stones, gold, copper, lead, clays and cement are fully treated). Tradesman–Jan. 1. 10000 w.

3457. The Coal Interests of the South. Ill. J. J. Ormsbee (A review of the coal operations in each of the Southern States, with description of a typical coal mine). Tradesman–Jan. 1. 6000 w.

*3476. Sudden Outburst of Gas in a Non-Fiery Mine. M. Leproux (From a communication to the *Annales des Mines*. Supposed to have been caused by a flow of marsh gas from an ad-

joining swamp, tapped by a bore-hole). Col Guard-Dec. 27. 2300 w.

*3478. A New Mining Theodolite (From *Berg.-u. Hüttenmanische Zeitung*. The Cséti theodolite is hung from the roof. Advantages claimed are great speed and ease in working in inclined headways). Col Guard-Dec. 27. 1700 w.

*3492. The Mount Bischoff Tin Mine, Tasmania. Ill. Henrich Wilhelm Ferdinand Hayser and Richard Provis (Abstract of a paper read at the Inst. of Civ. Engs., on the geology, method of mining, ore dressing, cost, losses, and water supply. The dressing works are illustrated). Ir & St Tr Jour-Dec. 28. 4000 w.

*3496. Mining and Metallurgy of Quicksilver in Mexico. James Mactear (A paper read at a recent meeting of the Inst. of Mining and Metallurgy. The various mines are briefly described). Min Jour-Dec. 28. Serial. 1st part. 3500 w.

*3497. Quicksilver Mining in the District of Guadalcazar, State of San Luis Potosi, Mexico. Henry F. Collins (A paper read before the Inst. of Mining and Metallurgy. The deposits are described with the mineral associations. An excellent paper). Min Jour-Dec. 28. Serial. 1st part. 1500 w.

*3507. Distribution of Power in Collieries Llewelyn B. Atkinson (A paper read before the South Wales Inst. of Engs. Dealing with the question of the economical production of power, with some remarks on the mechanical power in collieries). Elec Eng, Lond-Dec. 27. 4500 w.

Miscellany.

†3114. Comparative Taxonomy of the Rocks of the Lake Superior Region. N. H. Winchell (A comparison and explanation of the difference in nomenclature, between that of the author and Messrs. Walcott and Van Hise). Am Geol-Dec. 1800 w.

†3115. River Valleys of the Ozark Plateau. Oscar H. Hershey (The geological history of this region and the effects of erosion are fully developed). Am Geol-Dec. 7000 w.

†3116. A Study of the Belvidere Beds. F. W. Cragin (A distinctly geological discussion.) Am Geol-Dec. 9000 w.

3176. A Compressed-Air Power Transmission Plant in California. Ill. (The water, which is conveyed about five miles in a 20 in. steel pipe, with a maximum head of 775 ft., drives an 18 ft. 6 in. diameter Pelton wheel. The wheel is built on the bicycle plan, makes 110 revolutions per minute; it is direct-connected with two air compressors which deliver air at 90 lbs. per sq. in. pressure to the drills, 1000 ft. away). Eng News-Dec. 19. 800 w.

†3186. The Assay of Platinum. Edmund H. Miller (After reviewing the known methods in detail a "proposed method" is given for the assay of platinum in alloys or ores.) Sch of Mines Quar-Nov. 4000 w.

†3187. Lecture Notes on Rocks. J. F. Kemp (A very instructive discussion on the composition and classification of rocks. A tabular scheme is presented). Sch of Mines Quar-Nov. 7000 w.

†3253. On Silicides of Iron. G. De Chalmot (Experimental results obtained in the electric furnace). Jour Am Chem Soc-Dec. 400 w.

†3254. The Volumetric Estimation of Manganese. George Auchy (A comparison of Williams and Volhards methods, giving parallel analyses). Jour Am Chem Soc-Dec. 1200 w.

†3255. On the Estimation of Phosphoric Acid by Titration of the Ammonium Phosphomorlybdate Precipitate with Standard Alkali. B. W. Kilgore (The results of comparative analyses are given, with the idea of finding the best method, at the laboratory of the N. Carolina Experiment Station). Jour Am Chem Soc-Dec. 4800 w.

†3268. On the Composition of the Ohio and Canadian Sulphur Petroleums. Charles F. Mabery (Presented to the Am. Acad. of Arts and Sciences. The oils are considered peculiar by reason of the sulphur constituent. The chemical examination into their composition is fully described). Am Chem Jour-Dec. Serial. 1st part. 10000 w.

†3365. The Quarries in the Lava Beds at Meriden, Conn. William M. Davis (Three quarries in the Triassic (Newark) formation near Meriden, showing the vesicular upper surface of one lava bed under the dense basal portion of a later flow, and a number of fractures dislocating the double flow. Relation of these features to the geological structure of the district). Am Jour of Sci-Jan. 4600 w.

†3367. The Form of Isolated Submarine Peaks. G. W. Littlehales (The derivation of an equation whose curve will represent the contour of certain submarine mountain peaks). Am Jour of Sci-Jan. 500 w.

†3368. Section of the Cretaceous at El Paso, Texas. T. W. Stanton and T. Wayland Vaughan (The geological succession of rocks 698 ft. in thickness, with their accompanying fauna). Am Jour of Sci-Jan. 1500 w.

†3369. On the Epidote from Huntington, Morse, and the Optical Properties of Epidote. E. H. Forbes (Chemical and optical investigation of a specimen resembling zoisite). Am Jour of Sci-Jan. 1350 w.

3392. Pittsburg as an Iron Center. William Metcalf (Setting forth the advantages possessed by the city by reason of its vicinify to oil, coal and transportation; also discussing the smoke and labor problems). Ir Age-Jan. 2. 2700 w

3395. The Lake Ore Trade. F. B. Richards (General description). Ir Age-Jan. 2. 3000 w.

*3475. The Technical Literature of the Year. H. G. Graves (A notice of some of the principal articles appearing during the year on mining and metallurgical subjects). Col Guard-Dec. 27. 2700 w.

*3479. On the Occurrence of Lignite and Anthracite Around Hudson Bay, Canada. Robert Bell (A paper read before the General Mining Association of Quebec. The characteristics of the coal are given with notes on previous observations). Col Guard-Dec. 27. 2000 w.

MUNICIPAL ENGINEERING

Smoke Prevention.

IN an editorial in *Engineering News* (Jan. 2) the writer undertakes to answer the following questions: "(1) Has the citizen a right to demand that his neighbor shall not foul the atmosphere with smoke, if he can avoid it by any reasonable effort? (2) Is it possible, from a mechanical and business point of view, to burn soft coal without producing smoke in offensive quantities? (3) If it is possible, what is the best way to work to bring the reform about?"

The first of these questions is answered affirmatively, and the right affirmed is so obvious that we will not dwell upon the argument by which the validity of this answer is sustained.

As to the second question, it is alleged that "the secret of smokeless combustion" is "perfect combustion," and, contrary to a view that has recently gained ground, it is further asserted that complete combustion is not only theoretically possible, but commercially practicable. It says:

"There are on the market to-day a number of complete combustion, or smokeless, furnaces. Some of these secure the requirements by mechanical stoking, others by using fire-brick arches or partitions, and others by forcing air into the furnaces with steam jets or by a combination of these systems. Each of these furnaces has given more or less satisfactory results in preventing smoke, the excellence of the result in every case depending upon the completeness with which the requirements of good combustion were satisfied. In justice to the consumers who must bear the expense of new furnaces, however, it must be said that it is not only a furnace which will prevent smoke that is wanted, but a furnace which will do it with the greatest economy, and here the problem begins to assume puzzling ramifications."

In the previous part of this article the term "complete combustion" having been used in the absolute sense, as implying the condition of smokeless combustion, the qualification "more or less satisfactory" in the last quotation seems at least a partial denial in one form of what has been asserted in another form. "More or less" is a very elastic expression. And the last sentence in the quotation is an implied admission that it is not easy to discern the commercially practicable in the theoretically possible.

However, the writer holds it to be sufficient to say, in favor of his argument for the economy of smokeless combustion, "that mechanical stokers, or certain constructions of hand-stoked furnaces, can be had, which, in large plants, will economize enough in fuel alone to pay a fair return on the money invested in them. This is far from saying that all mechanical stokers, or all hand-stoked furnaces, are equally economical, or that either type is better than the other under all conditions.

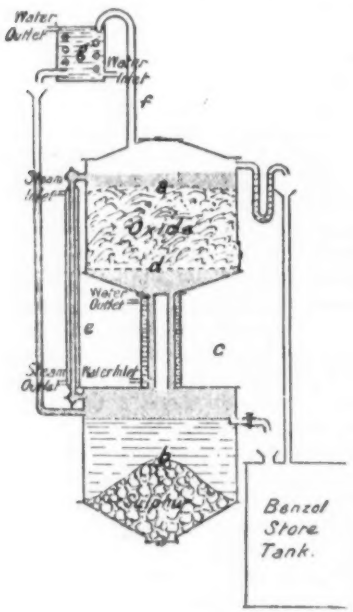
"To sum up, smokeless combustion is merely a question of a properly-designed furnace and smoke-stack, and proper regulation of the supplies of fuel and air. Of course, to install a furnace which meets these requirements means an increased first cost over the installation of the brick box with a grate at the bottom which often passes as a furnace. It is a cost, however, which the public is justified in demanding to secure the single item of smokelessness, and, when, as a matter of fact, the saving in fuel and boiler repairs soon pays for the improvement, there should be no hesitancy in demanding it."

The third question is answered as only it could be logically answered. Given the right to demand the abatement of the smoke nuisance and the commercial possibility of avoiding its creation, its abatement should be made as compulsory as is that of any other abateable nuisance. If furnaces exist that will burn soft coal without smoke, the health departments of municipalities should have power to compel their substitution for the existing

smoke belchers, and to prevent any further instalment of the latter in places where they can incommode citizens.

Cleansing Spent Oxid.

AT a recent meeting of the Southern District Association of Gas Engineers and Managers (England) Mr. A. E. Broadberry outlined a method for removing sulphur from spent oxid in gas works, leaving the latter in good condition for use again. If this can be done at a cost within certain limits, it will be an important advance. Preparations to test the process in practical working are now in progress at Tottenham, Eng., preliminary experiments on a small scale having giving sufficient



encouragement to warrant such a course. In this review we shall make a condensed abstract of Mr. Broadberry's paper, printed in the *Gas World* (Nov. 23), which will afford an idea of the nature of the process and of the apparatus. As the oxid was in no way prepared, but was treated in its normal condition, it may be relied on that the results could be reproduced on any larger scale.

The accompanying sectional drawing shows the arrangement of apparatus. Its simplicity is at once apparent. The upper or oxid vessel, *A*, is connected to the lower or sulphur vessel, *B*, by the water-jacketed pipe, *C*, with the filter or strainer, *D*, above it to prevent particles of oxid from passing down. A further connection between the two vessels is made by the steam-jacketed pipe, *E*. The ventilating pipe, *F*, is attached to a water-cooled condenser, *G*, the condensation being returned to the apparatus. Except for the stop-cocks for steam, water, etc., and the doors for charging and discharging, there is an entire absence of cocks, valves, or working parts to be manipulated. In fact, the process of working is as simple as the apparatus itself.

The oxid to be treated is placed in the upper chamber,—the lower one being about half filled with water,—and then benzol or similar solvent is put in up to about the overflow, entirely covering the oxid. To set the apparatus in operation, all that has to be done is to pass a small current of steam into the steam-jacket, and a flow of cold water through the water-jacket, and through the condenser. The heat communicated to the solvent in the pipe, *E*, induces an upward flow, and discharges it on the top of the oxid in a heated condition,—that is to say, at about 70° to 80° C. The return flow of the solvent is through the cooling pipe, C, which has its central portion occupied by a cylinder, the better to expose the solvent to the cooling surface; and this deprives it of its heat, returning it to the lower chamber at, say, about 25° C. The circulation thus produced continues automatically, so long as the steam and cold water are supplied to their respective places.

Benzol, at its temperature of 70° to 80° C. in the upper chamber, will dissolve 2½ to 2¾ lbs. of sulphur per gallon; but, when cooled to 25° C., on its return to the lower one, it will retain only ¼ lb. per gallon. Therefore it follows that for every gallon circulating, while there is plenty of sulphur in the oxid on which it can act, over 2 lbs. of sulphur are extracted from the oxid and deposited in the water at the bottom of the sulphur vessel. The

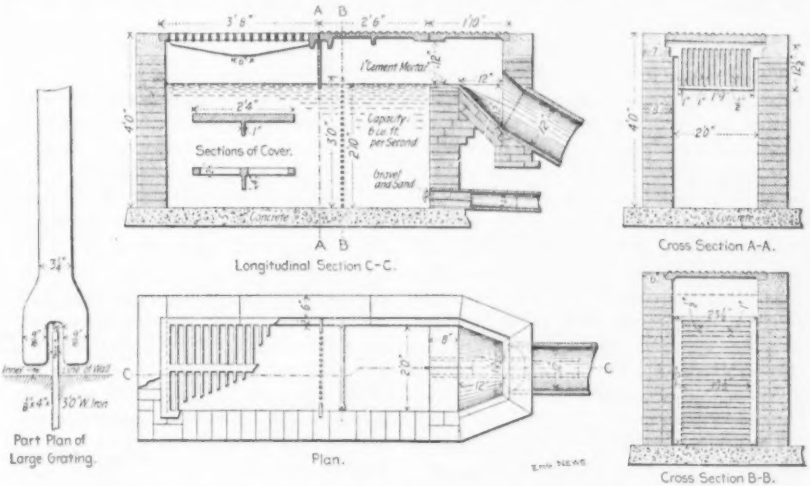
principle of action is the differential absorption of sulphur by the solvent at varying temperatures. Having filled the apparatus with spent oxid, water, and solvent, and turned on the steam and water, the apparatus may be left to itself until the extraction has ceased, when the benzol is drawn off and the oxid thoroughly steamed to distil and recover the benzol with which it is saturated."

A calculation of cost, and of the value of the recovered oxid, by Mr. Broadberry, shows a net profit of 26s. 3d. per ton of spent oxid treated, which, if it can be realized on a large scale, will be a material economy in the gas industry.

This catchbasin "was designed in 1893 to be used at points where water passes the common catchbasin, or where the volume of flow is unusually large.

"The inlet consists of a rectangular pit 2 × 6 ft. in size, with concrete bottom, brick walls, and cut-stone coping covered partially by perforated cast-iron covers, as shown. The inlet is set in the gutter, with the top of the plates depressed about two inches below the surface grade line. The water falls through the cover grate, and thence passes the two inner grates, shown in sections *B B* and *C C*.

"Most of the rubbish is thus removed, and the water discharged over the sill to a



DETAILS OF STANDARD CATCH BASIN PEORIA, ILL.

Catchbasin for Large Flows.

PEORIA, Illinois, is acquiring a reputation for the high character of its municipal engineering work. It is believed to be the first municipality to establish and maintain a complete testing laboratory, and, in paving and sewer construction, it probably compares favorably with any city of its size in the world, and with many much larger cities.

A sample of the municipal work done in this enterprising town is presented in the accompanying engraving, reproduced with a description by W. C. Parmley from *Engineering News*.

twelve-inch outlet pipe. This tile is partially choked by a gravel filter held in place by a perforated iron plate attached to a book-shaped iron handle. The filter can thus be easily removed and replaced whenever necessary.

"The accumulated rubbish may be removed after lifting the two inner gratings out of place, thus leaving a pit of convenient shape to be shoveled out.

"The inlet capacity is estimated at from twelve to fifteen cubic feet per second, with two inches of water over the grating, and the outlet capacity is estimated at six cubic feet, or about six times that of the ordinary

catchbasin. On steep grades the coping stone at the upper end is omitted and the adjacent pavement depressed, leaving a clear passageway under the upper end of the cover grating.

"About a dozen of these catchbasins were built the past season, and they have proved very satisfactory. The cost, including sewer connection, is from $55 to $65 each. In some cases a smaller-sized inlet is used, which differs only in having a pit 2 × 4½ ft., a depth over discharge sill of 10 in., and a 10-in. outlet pipe, giving about 4 cu. ft. per sec. discharging capacity. The cost is thus reduced about $5."

Purification of Water by the Archbutt-Deeley Process.

THIS process, which has been for a considerable time in use for industrial purposes, as in dye-works, chemical manufacturing, and the preparation for use in steam-boilers of water charged with mineral impurities, will, it is announced, be now applied on a larger scale for the treatment of hard waters in municipal water works. The *modus operandi* and the *rationale* of the process are, therefore, subjects of current interest to municipal engineers. We present an abstract of a description given in *The British Architect* (Nov. 29), wherein the process, as applied to water for steam-boiler supply, is explained by an eye-witness. The essentials of the process are the same when it is used for purifying municipal water-supply.

The purifier consists of a cast-iron tank divided into two equal parts by a transverse partition. The two tanks thus formed are fitted up exactly in the same way, the processes of filling, softening, and clarifying being carried on in one, while softened and clarified water is being drawn off from the other. Hard water is admitted to either tank by means of a supply-pipe, which is connected up to a pump or main. The water is run in up to the level of a gage mark on the side of each tank. While the tank is filling, quicklime and sodium carbonate (58 per cent. ammonia alkali), in proportions which depend upon the character of the water, are weighed out, and boiled up with water in a small chemical tank by means of live steam. The lime is first slacked in the hot water, and then the alkali is added and stirred until dissolved.

When the tank is full and the inlet valve has been closed, steam from the boiler is admitted to the blower, causing a current of water to circulate. The prepared chemical solution is slowly drawn into the circulating current, and thus diffused throughout the body of water. Air is then admitted through a pipe at the top of the blower, and is made to stir up some of the precipitate or mud (from previous operations) which lies on the bottom of the tank. Before being mixed with this mud, the new precipitate, which is very finely divided, will not coagulate, and takes a long time to settle; but, when the old precipitate, consisting of coarse particles, is stirred up, the fine particles attach themselves to the coarse ones, and subsidence of the precipitate is thereby greatly accelerated when the water is allowed to rest.

After the blower has been in operation for fifteen minutes the steam is turned off, and it is claimed that in about thirty minutes, or from that to an hour, very nearly all the precipitate will have settled to the bottom of the tank, and the water, even down to a depth of 6 feet from the surface, will not contain an average of more than about one grain per gallon of suspended matter. The chemicals, however, have been added to the cold water, and it is found that, when such water has been softened and afterwards becomes raised in temperature in the hot pipes, injectors, &c., connected to boilers, a further slight precipitation occurs, which gradually forms a coating on the interior of the pipes. To prevent this the water is carbonated. This has the effect of rendering permanently soluble the trace of hardening matter retained by the water.

The largest quantity of water under treatment at present is at the locomotive works of the Midland Railway Company, at Derby, where a plant softening 30,000 gallons per hour has been in successful operation since 1891. The hardest water under treatment is at a mill in Nottingham; it has 35½ degrees of hardness, and con-

tains both carbonate and sulphate of lime, as well as a large quantity of magnesium salts. By the treatment the hardness of the water is reduced to an average of 3.2 degrees, and the formation of scale is entirely prevented.

THE modern plumber, says *The Hospital*, is a kind of half sanitary engineer and half doctor. He must have such a knowledge of smells and tastes, with their good or evil effects upon the human organism, as the doctor possesses; and such a capacity for safely conveying away all waste and deleterious matter as the practical engineer can boast.

Thus educated and equipped, he can convert the most unwholesome of dwellings and public places into perfect arcadias for sweetness, provided you give him a plentiful supply of money. It is the worthy ambition of the Plumbers' Company of London so to utilize its funds—not very large funds, by the way—as to provide for every town or village in Great Britain as many thoroughly competent plumbers as the necessities of the country demand.

To secure the registration they ask for they require an act or acts of parliament; and everybody who has the least comprehension of the almost infinite importance of pure water, efficient drainage, and a sweet atmosphere must wish them success.

THE ENGINEERING INDEX—1896.

Current Leading Articles on Municipal Engineering in the American, English and British Colonial Engineering and Municipal Journals—See Introductory.

Gas Supply.

3021. On the Poisonous Action of Acetylene. M. N. Grehant, in *Comptes Rendus* (Comparative experiments supporting the conclusion that illuminating gas is much more poisonous than acetylene). Elec Eng–Dec. 11. 800 w.

*3025. Tower Scrubbers and Horizontal or Washer Scrubbers. William Newbigging (Objections to tower scrubbers and suggestions for improvement, with discussion). Jour Gas Lgt–Dec. 3. 5400 w.

*3026. The Installation of Carburetted Water Gas at Blackburn. S. R. Ogden (An important paper giving tabulated statements of working, materials consumed, and results obtained, with discussion). Jour Gas Lgt–Dec. 3. 4500 w.

*3090. Gasholder without Columns (Illustrated description of the largest gasholder ever built without columns, erected at Middlesborough, England). Eng, Lond–Dec. 6. 1100 w.

*3435. Carburetted Water-Gas at Blackburn. S. R. Ogden (A very interesting and full account, with tabulated results of test runs, of a new plant erected at Blackburn, England, under such restrictions in the contract for its construction as would bring out any deficiency in the process, which, notwithstanding, demonstrated its efficiency completely). Gas Eng's Mag–Dec. 10. 2100 w.

*3468. Thoughts and Recollections—1895 (A review of the gas industry for the year, in which progress, though slow, has not been wanting). Gas Wld–Dec. 28. 7000 w.

*3469. New Gas Works at Sleaford (Illustrated detailed description). Gas Wld–Dec. 28. 1200 w.

Sewerage.

*3310. Sewage Treatment. Douglas Galton (Paper read before the Sanitary Institute. Gives an account of the Massachusetts experiments, and the conclusions to which they point, the object being to open a discussion of the subject by members of the institute). Ind & Ir–Dec. 20. Serial. 1st part. 2000 w.

3325. A 94-in. Sewer and Storm Overflow at Denver, Colo. (Illustrated detailed description). Eng News–Dec. 26. 1800 w.

3326. A Catch-basin for Large Flow, Peoria, Ill. W. C. Parmley (Illustrated detailed description of an interesting construction for an exceptionally large volume of flow). Eng News–Dec. 26. 300 w.

*3352. East Molesey Drainage and Sewage Disposal Works (Illustrated detailed description. Separate system adopted. Storm water excluded. Two-page inset. These works constitute a model plant in many respects). Engng–Dec. 20. 2000 w.

3420. The Sewerage and Subsoil Drainage System of Newton, Mass. G. M. Warren (Illustrated detailed description with diagram of average cost per foot of pipe sewage, map, profile, etc., with two page inset). Eng News–Jan. 2. 4000 w.

3422. Sewage Purification at Pawtucket, R. I. George A. Carpenter (Illustrated detailed description giving plan of sewage, filter beds, and settling tanks, etc.). Eng News–Jan. 2. 1700 w.

Streets and Pavements.

3217. An Inequitable Proposal for Disposing of the Street Sweepings of New York (An editorial criticism of the conditions named by the street cleaning department, under which proposals for the final disposition of street sweep-

We supply copies of these articles. See introductory.

ings, ashes and other refuse collected in New York City were invited, and which failed to draw out proposals. It is shown that, under the conditions specified, proposals could not reasonably have been expected). Eng Rec-Dec. 21. 2000 w.

*3224. About Paving Materials (A consideration of the wearing qualities and general excellence of various kinds of materials, concluding that the experimental stage is not yet passed). Can Arch & Build-Dec. 1000 w.

*3405. Standard Specifications and Methods of Testing Paving Brick (Report of Edward Orton, Jr., secretary of the commission on standard specifications, appointed by the National Brick Mfr's. Assn.). Pav & Mun Eng-Jan. 3800 w.

Water Supply.

*3004. Locating a Public Water Supply. Daniel W. Mead (Showing how topographical, hydrological, and hydro-geological conditions affect the choice of a source of water for public use). Eng Mag-Feb. 3500 w.

*3094. Water Purification and Softening by the Archbutt-Deeley Process (Illustrated description of apparatus and process, and an account of a public test made to demonstrate the value of the process, and its practicability for large quantities of water for town use). Ry Wld-Dec. 1200 w.

3179. A Simple Apparatus for Collecting Samples of Water at Various Depths. Ill. George Chandler Whipple (Descriptive). Science-Dec. 20. 800 w.

3218. Water-Works for Small Cities and Towns (First part is introductory and treats of surveying watersheds, run off from watersheds, minimum run off, storage capacity required, gauging small streams, and meaning of chemical analysis. Three tables are also given: (1) showing the amount of storage required to make available different daily volumes of water per sq. in. of watershed; (2) discharge of weir 1 ft. long; (3) water analyses). Eng Rec-Dec. 21. Serial. 1st part. 4800 w.

3278.—75 cts. Uniformity of Methods in Testing Water Meters. Ill. John Thompson. with Discussion (Affirms that it is time water meters should be tested by uniform methods, and sets forth particulars in which uniformity should be attempted. It also describes an apparatus and a method for the more accurate testing of meters) Jour N Eng Water Works Assn-Dec. 10500 w.

3280.—75 cts. The Metropolitan Water Supply of Massachusetts. Albert F. Noyes (A general synopsis of the work done and in progress for obtaining water supply for the metropolitan district of Boston. Discussion). Jour of N Eng Water Works-Dec 3000 w.

*3345. The Chemical and Biological Examination of Potable Waters. Edward F. Willoughby (Abstract of a paper read at the meeting of the Sanitary Assurance Association. The subject is treated from only two standpoints, namely, the ascertaining of the fitness of water for drinking and its qualities for other domestic uses. The examination discussed, therefore, differs materially from an exhaustive chemical analysis of mineral water, and includes the use of the microscope as well as chemical tests for nitrogen, etc). San Rec-Dec. 20. Serial. 1st part. 1400 w.

*3358. Water Supply, Past and Present (Interesting historical account, touching on its combination with architecture). Ill Car & Build-Dec. 20. 1600 w.

3531. Experimental Water Filter Tank at Pittsburgh, Pa. (Illustrated detailed description. The tank is built of "Cementine," a combination of metal lath and cement). Eng News-Dec. 12. 1500 w.

Miscellany.

†3015. Municipal Fire Insurance. Robert Donald (The broadest paternalism is advocated. The article supports the general thesis that "there can be no finality to such expansion of duties as fall to public authorities; and then proceeds to discuss alleged advantages which would result from municipal fire insurance). Contemporary Rev-Dec. 6200 w.

*3040. Description of the Shoreditch Refuse Destructor Works. G. Manville (With an introductory consideration of principles involved). Ind & Ir-Nov. 29 4500 w.

*3084. The Cost of Lighting by Gas and by Electricity. A. P. Trotter (A comparison attempted but considered impossible without further data, but concluding that if the two systems were placed on equal conditions, the cost of gas lighting would largely exceed that of the contract for electric light). Elect'n-Dec. 6. 3000 w.

*3106. Practical Disinfection. Edward F. Willoughby (Unsatisfactory work of municipal authorities alleged, and suggestions for improved methods). San Rec-Dec. 6. Serial. 1st part. 1300 w.

*3119. Electrolysis Prevention at Newark, New Jersey. Harold P. Brown (Description of a method of making a thorough examination of the water and gas pipes). St Ry Rev-Dec. 15. 3800 w.

3138. Municipal Art (Editorial discussion regarding the proper site for the memorial to be erected to the soldiers and sailors of the War for the Union). Gar & For-Dec. 18. 1200 w.

*3196. The Paris Municipality and Electric Installations (Editorial consideration of the rules referring to electric power stations and distribution of the current in Paris, with general summary of the restrictions placed upon industrial companies). Engng-Dec. 13. 3900 w.

3279.—75 cts. Tests of Articles of Commerce, to be Conducted by the Association. Clemens Herschel (A proposition that the Association shall cause tests of articles used in waterworks installments at the expense of the Association. Discussion). Jour of N Eng Water Works Assn-Dec. 3500 w.

*3404. A Municipal Testing Laboratory. Ill. A. D. Thompson (Illustrated description of what is believed to be the first complete testing laboratory yet established. It is at Peoria, Ill.). Pav & Mun Eng-Jan. 2000 w.

RAILROADING

Articles of interest to railroad men will also be found in the departments of Civil Engineering, Electricity, and Mechanical Engineering.

Discipline Without Suspension.

THE dissatisfaction among railway employees during the past few years has had such an undesirable effect upon our industries, and destroyed the *entente cordiale* among railway men to such an extent, that any remedy proposed is very welcome.

Locomotive Engineering (Jan.) contains a second article by Mr. Geo. R. Brown, the general superintendent of the Fall Brook Railway, on the methods employed on that road to discipline their employees:

"The usual penalty for a serious violation of rules on American railroads is dismissal from the service. Minor infractions are usually punished by depriving the offender of employment for a fixed time,—ten, thirty, or sixty days; a few roads have adopted the European practice of direct fines. In my estimation, as a rule, these forms of punishment are unjust and inhuman, as a law cannot be effective without a penalty. Penalties are imposed for two purposes: first, to uphold the law and prevent its further violation, and, second, to reform the violator."

"Suspending sentence" is better than immediate punishment, as there are few men who make no mistakes, and we learn best how not to do by means of the errors we make. Every wreck, every accident, every mistake, every loss, has taught its lesson, and these are of no less value to the railroads and to railroad men than the successes. I practise making every mishap a lesson to every man on the road.

"In order to make every accident and incident happening on the road a lesson to all the train men, I established twelve years ago a Miscellaneous Bulletin Board. On this we post up brief accounts of the mishaps and other occurrences on the line, pointing out how such trouble could be avoided, etc. This board is closely scrutinized. We do not mention names, but of course, the men know 'who's who' in most cases. To show the class of notices posted, I inclose a few that have appeared. We usually have a notice up ten days:

"I regret to announce that thirteen out of forty-six freight- and coal-train conductors who have worked the full year ending with May 31, 1895, have lost their $60 premium. Last year there were but three out of forty-seven who lost it.

"We believe it is possible, and we hope that the coming year every conductor in the employ of the company will be entitled to this premium, ending with May 31, 1896.

"Please remember that it remains entirely with yourselves whether you get it or not. The original notice stated that your services must be entirely satisfactory for the full year in order to ensure it. Please make diligent effort, each and every one of you, to procure this $60 with your May pay for 1896.

"Caboose No. 27 had to have a new set of springs put under it, on account of being loaded too heavy with links, pins, etc. There was taken out of this caboose 2,020 pounds of unnecessary material.

"Conductors will only allow such material in their cabooses as may be actually necessary, and not load the boxes down for the purpose of making the springs ride easier; and it is unnecessary to haul a ton of this material around month after month.

"I understand that recently, at a night telegraph office, the semaphore light had gone out and the blade was wrong when a train arrived at the station. This was not reported to Corning office by the train so finding it, and should have been done from the next telegraph station. All conductors and engineers will please report any violations of this kind at once.

"Please remember that employees' lives are jeopardized when operators do not strictly comply with rules and regulations, and parties who know and do not report these things will be considered as guilty of negligence as the operators themselves.

"We also pay premiums to section foremen for the best-kept track. Three premiums on each division, $40, $20, and $10 respectively. The benefits derived are even more than expected. The condition of the track is at least twenty-five per cent. better, and the track pay-rolls for the year ending October 31, 1893, was $37,199.66, and for the year of 1894 $41,842.46 less than the average for the eight years before premiums were given.

"For the trainmen we keep a record

book. This book is never shown to any employee, except that page which is his personal record.

"In it I write down a brief statement of every irregularity for which a man is responsible; this record takes the place of the 'lay off,' and is dreaded fully as much; the man goes to work at once, and no one but himself suffers, and he only in reputation at headquarters.

"We are very careful in the selection of our men; promote all our own engineers and conductors; and in a few months or a year or two our record tells us whether they are adapted to the business or not. We have engineers who have been running here more than twenty-five years without a scratch of the pen against them; while others, who have been running as many months, have quite a page full of irregular circumstances; but down near the bottom of such a page can generally be found the words 'Discharged—incompetent.'

"It is well understood that we do not wish to retain in the service men who deliberately deceive us about mishaps on the road; we want the 'straight' of every matter, and we want it at first hands. It would be a very lively detective who could get to my office sooner than some of the men who are responsible for the accidents. If it is not serious enough for dismissal, the matter is overlooked or made a matter of record, and the man goes out on his regular run. Then the 'Miscellaneous Board' has another object lesson on it.

"If there is anything that will stimulate a good man, who has become careless enough to make a lapse of duty that 'gets him in the book,' more than that simple record, I do not know what it is. It is a mistake to disgrace an employee before his fellows, as it is liable to make him revengeful and cause him to lose interest in the success of his work. A competent man will endeavor to keep a clear record, and all others had better be gotten rid of for the good of the company. The Pennsylvania Steel Co. employs a similar system.

"On many roads there is a great want of cordiality or confidence between the men and the officials immediately over them. In too many cases a suggestion from a trainman to an officer would be resented as an unwarranted interference. It seems to me this is not in the interest of the railroad company, however much it may enhance the dignity of the official,—who is himself 'only one of the hired hands,' with a little more responsibility.

"I have found suggestions from the men of vital importance in matters of detail, and every man in the service knows that the rule and motto at headquarters is, 'Suggestions are always in order.'"

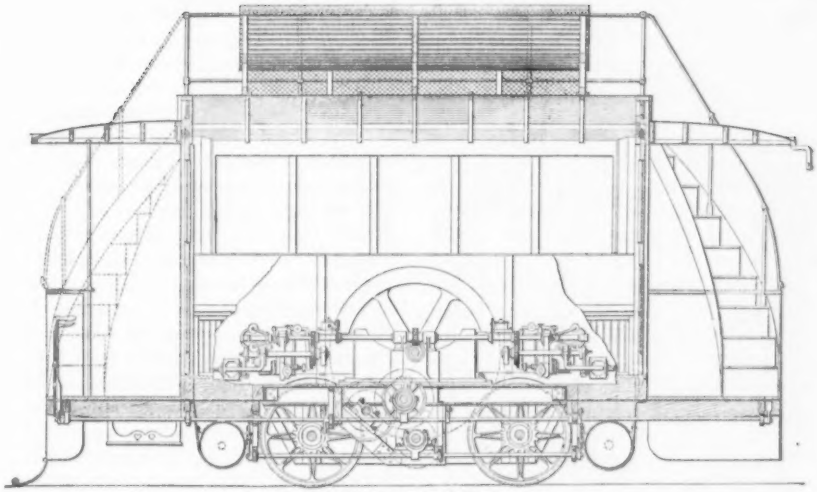
The author commends the system very highly, and says: "It has worked so well for years that I have an abiding faith that it will work anywhere, and in every case in the interest of better service."

Gas Traction for Tramways.

In our issue of last November, under the title "Gas Street Railway in Dessau," will be found a description, with data, of the operation of this unique passenger line. We now give some further particulars, with a cut illustrating the method of construction of the car and driving mechanism, taken from the *Journal of Gas Lighting* (Dec. 10). The installation is described as follows:

"Gas-motor cars, built on the Lührig system, have been in successful operation in Dresden since July last year; and the results have been such as to lead to the equipment of a line in Dessau worked entirely by means of gas cars. Coming nearer home, Lührig cars were about the same time placed upon the line running between Thornton Heath and Croydon, England.

"The accompanying illustrations represent a sectional elevation and a cross section of a gas-motor car. It will be seen that it is self-contained, and of the ordinary type, with 'garden' seats on the top. All the machinery is enclosed and concealed from sight; it is cleanly in working, and does not cause nuisance by vibration, heat, or smell. The motor is a double-cylinder gas-engine of the 'Otto' model, so arranged that all parts can be easily reached.

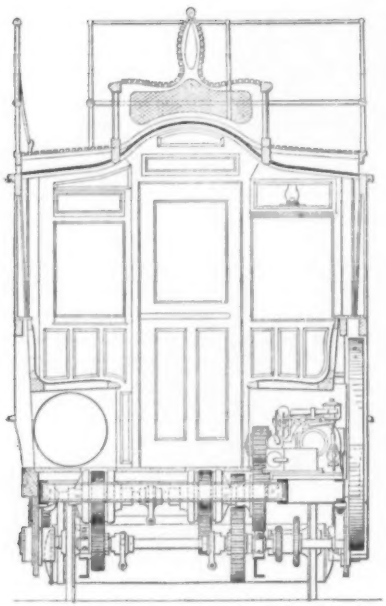


LONGITUDINAL SECTION.

While on the road, the engine is completely under the control of the driver, who can reverse the car or reduce the speed at will. The gas is taken from the mains supplying the town, compressed to about 120 lbs. per square inch, and then delivered by an ordinary india-rubber tube to the car, where it is stored in reservoirs carried underneath, containing, when fully charged, about 300 cubic feet, or sufficient gas to enable the car to travel about eight miles without any risk of the store being exhausted during the journey. The refilling of the reservoirs usually takes about a minute and a half; and this can be done at the starting-place, or at any convenient point on the road where a compressing plant can be erected. This plant is of a very simple and inexpensive character, and no noise, soot, or smoke is produced by it. At Dessau the compressing station is only in use for three hours a day; and a compressor driven by an 8-horse power engine suffices to work twenty cars continuously. On the introduction of gas-driven tramcars in Dresden and Dessau, questions were raised in certain quarters as to a possible danger to the public from storage of compressed gas, and fears were entertained that explosions would result. Of course, these proved to be groundless. There is no light of any kind upon the car, the ignition necessary for starting the gas-engine being done electrically.

"At Dresden, the line is not quite three miles long, with easy gradients. The cars carry about twenty-five passengers, and they run at the rate of 7.2 miles an hour, including stoppages. The total quantity of gas paid for in the first half of the present year, for all the purposes of the line, was 36.8 cubic feet per car-mile, the cost of which, at 2s. 6d. per 1,000 cubic feet, would be 1.23d. But even these low figures must not be taken as representing the best that can be done. At Dessau the length of the two lines in use is not quite three miles each; and the gradients are not heavy, the cars taking them without reduction of speed. The curves, however, are trying. The total quantity of gas used in the four months ending April last (in which period the cars had run 54,500 car-miles, and carried 196,460 passengers) was 29.8 cubic feet per car-mile, which, at the above-named rate, would work out to just under 0.9d. per car-mile, instead of 1.23d. as at Dresden. At Dessau, the cars actually run about five miles per charge of gas; but this distance could well be increased."

Some idea of the cost of running may be obtained from the cost at Croydon, England. The gas is there procured at 2s. 10d.



CROSS SECTION.

per 1,000 cu. ft., making the running expenses "less than 1d. per mile run, as compared with 2½d. for electricity on the trolley wire system, or 5d. for horse traction." Mr. Corbet Woodall, a prominent engineer, thinks no other power for tramcar traction can be provided at so low a cost as gas, and with so few objectionable features.

Tramway Motive Power.

THE question of relative economy is the primary one which determines what system of propulsion shall be used on any road. The secondary questions of speed, comfort, noise, safety, etc., apply to all systems, whether horses, steam, cable, compressed air, oil engines, gas engines, water jet, electricity, or any other means constitute the moving power. In *The Practical Engineer* (Nov. 15) an article is condensed from the *Pall Mall Gazette* on the various systems employed in England. Speaking of steam and horse traction, it says: "On the basis of financial results there is little to choose between horses and steam as the motive power for tramways. Steam has, indeed, a number of objectionable features which must debar it from ever making very great headway and it is pretty generally recognized that it is no more the ideal force for tramway propulsion than horse traction. . . . . Compressed air motors have been tried, and in France it has met with a certain degree of success; but in London they failed utterly, by reason chiefly of the heavy cost of operation. Oil motors have also been tried; and there is one company in London prepared to supply trains worked by gas. Oil is so far only in the experimental stage, and may be left out of count. The present tendency is very markedly in favor of either electric traction or cable haulage. The first of these is being more generally applied by means of overhead wire conductors fixed in position over the tracks in the streets. . . . The other method of electric traction is worked by conducting the wires in a conduit under the tramway track. This conduit system is followed at Blackpool and Budapesth. It is open to more objection on the score of danger than the overhead system, the great objection to which is the unsightliness of the posts and wires. Birmingham enables us to compare the various methods, as it has the four principal systems at work,—horse, steam, electricity, and cables,—and the following table will give a good notion of the relative profit in that city. The figures are for the last available year:

	Miles run by cars.	Average receipts per mile run.	Expenses per mile run	Net profits per mile run.
		Pence.	Pence.	Pence.
Steam....	1,225,996	15.99	11.22	4.77
Horse....	647,652	10.93	10.12	.81
Cable....	641,161	12.69	6.32	6.37
Electric..	140,993	16.38	6.55	.17 (loss)
Aver's.	—	13.99	11.05	2.94

Some Notable English Engines.

AMONG the noteworthy features of our modern locomotive construction is the apparent unnecessary height of boiler above the driving axle. This was not always thus, and the present development from low boilers is shown in an interesting article in *The Railroad Gazette* (Nov. 15), which begins as follows:

"It is not the object of the present

article to deal with ancient locomotives, but those belonging to what may be called the medieval period of railroad history, when the early engines were found to be unequal to the enormous increase of traffic during that time.

"The life of a locomotive superintendent in those days was certainly not a happy one, for, in addition to the numerous difficulties and responsibilities of his office, he had to solve the problem of designing powerful economical engines to run on iron rails weighing from 44 to 75 lbs. to the yard. He was between two fires: on the one hand, his directors were ordering him to build new engines to draw heavier trains at increased speed, and, on the other, the engineer of roadway was complaining that the ponderous locomotives were battering out the rails. Then again, he always had to face the periodical grumble that his engines were burning too much coal.

"There was also another obstacle to his progress, which, remarkable as it may seem, was an imaginary one. For many years it had been an established theory, beyond question, that the boiler of a locomotive should be kept as near to the rails as possible, to ensure steadiness and safety at high speeds. In order to meet this supposed requirement and at the same time to employ large driving wheels, engineers spent a great amount of time and energy in building a variety of experimental and costly machines, some having the driving wheels and motion on a separate frame from the boiler, and others having the driving axles placed through the firebox and smokebox by means of water bridges, with fearful and wonderful arrangements of bell crank levers and rocking shafts between the cylinders and driving wheels. One of these 'mills' seen by the writer never even traveled on rails, but, after being jacked up clear of the ground and tried under steam, was laid aside as useless. Perhaps the most widely known example of the 'low boiler' theory was Francis Trevithick's 'Cornwall,' built in 1847 for the London & North Western; having the driving axle *above* the boiler and the boiler center only 2 ft. 8 in. from the rails. With such an engine before us as the New York Central '999,' having the boiler center 8 ft. 11½ in. from the rails, it is difficult to understand why such a fallacy as 'low boilers' should have occupied the minds of practical men for so many years; but such is the fact."

The editor then describes a number of types of locomotives covering a period limited by the years 1840 and 1870, and concludes:

"All the foregoing engines were able to draw their trains at average speeds which will compare favorably with those of the present day. They were of the highest finish, and shone like glass; the boilers and wheels were painted a bright green, the frames a dark red; the steam dome and safety-valve covers were of polished brass, with sometimes a polished copper cap to the chimney.

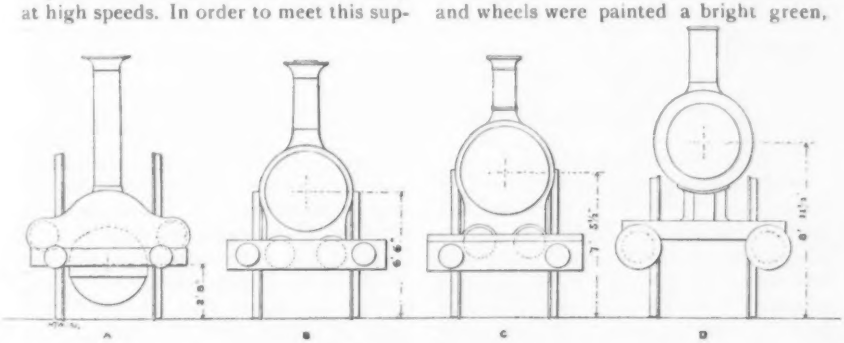


Fig. 6.—Comparative Heights

"A diagram (Fig. 6) is given for the purpose of comparing the heights of some of the engines under notice,—namely, *A*, Trevithick's L. & N. W. engine Cornwall; *B*, average height of express engines of the

period; *C*, McConnell's L. & N. W. engine 373; *D*, Buchanan's New York Central engine 999."

Comparison of Compound and Simple Locomotives.

As the result of a series of observations on the Chesapeake and Ohio Railway, *The Railroad Gazette* (Nov. 22 and Dec. 6) publishes tables showing a saving by the compound over the simple locomotive of about 400 tons of coal per annum in the first case, and at the rate of 500 tons per annum during the month of August, 1895.

COMPARATIVE PERFORMANCE OF SIMPLE RICHMOND ENGINES AND RICHMOND COMPOUND, IN SERVICE ON THE CHESAPEAKE & OHIO RAILWAY.

Engine number.	Engine mileage.	Loaded freight car mileage.	Cost of repairs.	Repairs per 100 miles run.	Tons of coal used.	Miles per ton of coal.	Average cars in train.	Pounds coal per Eng. mile.	Pounds coal per car mile.
Average of 10 simples.....	70,066	2,350,281	$2 194.24	$3.13	4,593	15.25	37.5	131	3.91
Compound No. 140.....	85,236	2,891,793	2,441.70	2.88	4,262	20.00	38.7	100	2.95
In favor of compound for two years to Dec., 1894				7.9%	.....	31.13%	3.5%	23.7%	24.5%

C., C., C. & ST. L. RY.—12 SIMPLE ENGINES AND RICHMOND COMPOUND NO. 472. AUGUST, 1895.

Engine number.	Size of cylinders.	Miles runs.	Pounds coal consumed.	Miles run to 1 ton coal.	Number loaded cars hauled 1 mile to ton coal.	Pounds coal per loaded car hauled 1 mile.	Number loaded cars per train.
Average 12 simple engines...	19 in. × 24 in.	3,464	316,333	21.90	505.4	3.96	23.1
Compound No 472.....	19 in. & 30 in. × 24 in.	3,061	208,060	29.43	691.6	2.89	23.5
In favor of Richmond compound No. 472, for August, 1895...				34.3%	36.8%	27%	1.73%

Light Railways in Hungary.

OWING to the interest manifested in England in "farmers' railways," the foreign office has issued a circular to its representatives on the continent requesting information on light railways in use in the countries in which they reside. The first report comes from Hungary, where the zone system is very fully developed. "In the year 1892 there were sixty secondary railways in Hungary, of a total length of 3,722 kilometers, the ordinary gage being 1.435 meters and the narrow gage 0.76 meters. The capital necessary for their construction has, as a rule, been obtained by private enterprise, to which the State, the municipalities, the parishes, and others have contributed, either in fixed amounts, in subsidies, or by offering some guarantee, according to their interest in the railway to be constructed. The State also remunerates such railways for carrying the mails, either by yearly payments of certain amount in proportion to the services actually rendered, or by arranging an annual sum payable for a certain series of years. There are also instances of municipalities guaranteeing the yearly payment of interest, and the quota of amortization of the debentures issued by such railways. At the same time it must be mentioned that these shares are, for the greatest part, held by the contributors, who have the greatest economical interest in the construction of the lines, owing to the facilities of communication thereby obtained, and to the consequent increase in the value of their estates. As to the State contributions, they are counterbalanced by the increase of the traffic of their own lines, as well as by the general economic development to be expected in the districts through which the secondary lines pass.

"As a matter of fact, only eight out of the sixty secondary railways have paid dividends on their ordinary shares up to the year 1892. In that year their income in proportion to their actual capital was 3.45 per cent., or, in proportion to the

nominal capital, excluding the ordinary shares, was 4.61 per cent. The percentage of the deficit, without reckoning the ordinary shares and only taking into consideration the sums required to meet the interest and the quota of amortization, in 1892 was 11.09 per cent. The receipts in 1892 were: per passenger, 1.70 kreuzer about $\frac{3}{10}$d) per kilometer, and on goods per ton 3.62 kreuzer (about $\frac{7}{10}$d.). The conclusion of the report on these railways in Hungary is of a very important nature, for it states that whether, and to what degree, they have stimulated the production and sale of dairy products, eggs, fruit, and vegetables, and products of other small industries in the districts through which they pass, cannot be ascertained. Without such information the rest of the report is of little value." These facts are of interest, not only to English promoters, but also to those considering similar projects in the United States, where population is much more thinly distributed than in Hungary.

THE RAILWAY AGE (Jan. 17) reports the cost of operating of the Chicago City Ry. Co., as follows in cents:

	1895.	1894.
Cable lines	10,240	9,972
Horse car lines	30,550	25,393
Electric lines	14,776	16,904
All lines	12,796	13,487

THE ENGINEERING INDEX—1896.

Current Leading Articles on Railway Affairs in the American, English and British Colonial Railroad and Engineering Journals—See Introductory.

*3008. Railroad Accident and Emergency Service. W. L. Derr (Detailing the duties devolving upon, and the qualities requisite in, a railroad wrecking crew, and describing a wrecking equipment and its uses). Eng Mag-Feb. 4200 w.

3022. Functional Equivalents versus Mechanical Equivalents (Commenting upon the recent air brake decision the editor says that it is an application of the idea that in determining questions of patent infringement, functional equivalents deserve prior consideration over mechanical equivalents). R R Car Jour-Dec. 1200 w.

3023. Making Supplies in Railroad Shops (The editor contends that there can be no general decision as to whether railways should make their own supplies and repairs, as it depends upon other contributory circumstances than that of time or economy). R R Car Jour-Dec. 1500 w.

3024. The Revision of the M. C. B. Rules of Interchange. George S. Hodgins (Suggestions and observations on the rules governing the interchanging of cars, traffic and repairs on connecting railroads). R R Car Jour-Dec. 2000 w.

3037. Railway Signaling. W. McC. Grafton (From the Bulletin of the University of Wisconsin, No. 6. The article is prepared by the signal engineer of the Pennsylvania lines west of Pittsburg). Sci Am Sup-Dec. 14 Serial. 1st part. 3000 w.

†3038. Steam Heat on Passenger Equipment (A communication on the use of steam heat and the advisability of using a steam trap. A lengthy and interesting discussion followed the reading). Cent Ry Club-Nov. 9400 w.

*3039. The Electric Lighting of Railway Carriages. Ill. (A device consisting of dynamo and accumulator run from car axle. The advantages are stated and a trial described). Ind &Tr-Nov. 29. 3000 w.

*3082. Railway Train Lighting (Favoring electric lighting and describing a system by which each coach is self-contained, having each a small set of accumulators). Elec Rev-Dec. 6. 1600 w.

*3093. An Electro-Magnetic Tramway System (A new device using neither trolley nor subway connections. An illustrated description of a trial line in Philadelphia, Penna.). Ry Wld-Dec. 1800 w.

*3095. The Modern Application of Electricity to Traction Purposes. Philip Dawson (A paper read at the British Asso. An exhaustive article prepared with care and containing valuable statistics). Ry Wld-Dec. 4500 w.

*3101. Light Railways (An editorial dealing with the questions of government aid, gauge, rates, etc., anticipating a report to be issued by one of the two light railway associations just formed). Engng-Dec. 6. 2500 w.

*3120. Possibilities of Long Distance Transmission from Electric Railway Steam Plants (The opinion is expressed that the present methods must change very radically, if a central power station is to possess any advantage over auxiliary stations). St Ry Rev-Dec. 15. 1400 w.

*3121. Track and Overhead Department Economics. J. W. Greer (The advantage of the T rail and the best method of laying track is discussed). St Ry Rev-Dec. 15. Serial. 1st part. 3000 w.

*3122. The Galt, Preston and Hespeler Street Railway and Its Freight Service. Ill. W. H. Lutz (Description of a Canadian line with combined passenger and freight service. The freight department is quite successful). St Ry Rev-Dec. 15. 1400 w.

*3123. Examination Questions for Motormen and Conductors (The questions are given in full, 26 for the conductor, and 37 for the motorman, as asked by the Oakland Consoli-

We supply copies of these articles. See Introductory.

dated Street Railway). St Ry Rev–Dec. 15. 1500 w.

3132. The Trolley Opinion (Opinion of Judge Townsend in the case of Thomson-Houston Electric Company vs. The Winchester Avenue Railway Company. An important decision affecting the electric railway industry). Elec Ry Gaz–Dec. 14. 3500 w.

3139. Railroad Racing (Editorial. In considering the qualifications of locomotives for high speed performances, the essentials discussed are,—sufficient adhesion of wheels; adequate steam supply; and driving mechanism). Am Eng & R R Jour–Dec. 12. 2200 w.

3140. Some Difficulties of Electrical Railroading (The difficulties encountered in applying motors to car axles, the disadvantage of two motors, and stating that 30% of the power is consumed by the gears). Am Eng & R R Jour –Dec. 12. 2000 w.

3141. Description of a Locomotive Depot for the Accommodation of 180 Engines and Tenders. W. G. Scott (Paper read before the Liverpool Engng. Soc. The shed contains 30 lines of rails, each holding six engines. The principal features are briefly described). Am Eng & R R Jour–Dec. 12. 1600 w.

3147. The Annual Cost of a Freight Car to its Owner. Edmond Gardley, in *Equipment Guide* (The annual charge against box cars is calculated at $83; against gondolas $74.70). R R Gaz–Dec. 20. 1800 w.

3148. Notes on English Railroads. J. W. Thomas, Jr. (Permanent way, carriages, wagons, locomotives, signals, etc., are described as they are applied in England. The article is both interesting and detailed). R R Gaz–Dec. 20. 3000 w.

3177. Automatic Switch Indicators. W. W. Salmon (Paper read before the Railway Signaling Club. Description of various installations). Eng News–Dec. 19. 1800 w.

*3206. The Midland Railway Company's Locomotive Works at Derby (A very well illustrated description of works originating in 1844 and now covering 166 acres of ground, of which 44 acres are occupied by buildings). Eng, Lond –Dec. 13. 12000 w.

*3215. Gas Traction for Tramways (Illustrated description of a gas motor mechanism for driving street cars at Dessau). Jour Gas Lgt–Dec. 10. 1000 w.

3223. The Reading Plan at Last (A radical departure in railroad organization, which is expected to place the Reading Railroad on a solvent basis). Bradstreet's–Dec. 21. 1400 w.

3226. Underground London. From *Chambers' Journal* (An article considering in general the rapid improvement of traveling facilities, and specially the Central London Electric Railway about to be built). Am Arch–Dec. 21. 1600 w.

3237. Freight Car Doors (Discussion before the Western Railway Club upon the qualities requisite for good freight car doors). Ry Rev–Dec. 21. 3200 w.

3241. The Remodeled Shops of the Fitchburg Railroad at Keene, N. H. (A plan of the new arrangement is given, with description). Ry Age Dec. 20. 700 w.

3242. Economy in the Selection, Use, and Renewal of Cross-Ties. H. G. Hetzler (A first prize paper, from the Roadmasters' Assn. The paper is thorough and practical). Ry Age–Dec. 20. 3300 w.

3243. The Hanging of Brake Beams. Ill. (An equalizing device to prevent the tilting forward tendency of trucks. The device is in use on the D. & H. C. Co.'s lines). Ry Age–Dec. 20. 700 w.

*3257. The New Railway to Astrakhan (Advantages presented with reasons for the necessity of the line. The two routes discussed). Bd of Tr Jour–Dec. 900 w.

3291. Tests of Gas and Lamps for Car Lighting (A report by Professors Chandler and Denton on tests with both Pintsch and city gas in Argand lamps of the Pintsch and Gordon-Mitchell types. The tests were made for the Lehigh Valley Railroad). R R Gaz–Dec. 27. 1700 w.

3299. Improved Mail Cars. Ill. (Description of some new wreck-proof and robber-proof mail cars. They are without platforms, close coupled, very strongly framed, doors and roof protected by iron plates, and are brilliantly lighted by gas and oil). Business–Dec. 1000 w.

3321. Recent Designs in Metal Fences for Railways (An illustrated description of some cheap wire fences with iron posts). Eng News –Dec. 26. 1200 w.

3327. Railway Construction in 1895 (Statistics, by years and by states, of mileage built). Ry Age–Dec. 27. 400 w.

3328. Wooden Cross Ties. H. W. Church (Second prize paper on the best practice in selecting, laying, removing and adjusting railway ties). Ry Age–Dec. 26. 1700 w.

*3329. Reconstruction of the Car Ferry Transfer Aprons at Port Costa and Benicia. John B. Leonard (An apron connecting the transfer boat with the R. R. tracks. It consists of five longitudinal bowstring trusses 100 ft. long It is 44½ ft. wide and carries four tracks. Detail drawings are given). Jour of Assn of Eng Soc–Nov. 2500 w.

*3409. Discipline Without Suspension. George R. Brown (An excellent system of rewards for good work by employees and the effects of the system. Should be read by every superintendent). Loc Engng–Jan. 4800 w.

*3410. The Northwestern's Locomotive Testing Machine (A device for testing the efficiency of engines after coming from the shop, with the idea of improving on possible defects). Loc Engng–Jan. 1200 w.

*3418. Construction and Maintenance of Railway Car Equipment. Ill. Oscar Antz (An extended description of each part in detail). Am Eng & R R Jour–Jan. Serial. 1st part. 3000 w.

*3419. Passenger Train Detentions (Editorial. An examination into the causes). Am Eng & R R Jour–Jan. 1300 w.

3424. Railroad Travelling in Spain. S. W.

D). (An entertaining letter to the editor, giving many details of operation of the roads through this interesting country). R R Gaz-Jan. 3. 2500 w.

3425. Railroad Economics (The last of a course lectures by Mr. Ackworth, delivered in London. It touches upon the municipal railroad systems on the continent). R R Gaz-Jan. 3. 1400 w.

3426. The King Bridge Co.'s Ore Hoists and Conveyors Ill. (A conveyor of simple design used in unloading from boats to cars). R R Gaz-Jan. 3. 1000 w.

3428. Matching Re-Sawed Rails (Method used to assort and distribute re-sawed rails in order that the joints may match). R R Gaz-Jan. 3. 800 w.

3430. High Speed Compounds (Comparison between simple and compound locomotives, especially at high speed). R R Gaz-Jan. 3. 1500 w.

3431. A Study in Operating Expenses—Periodic Traffic. R. L. D. (Experience of the Southern Pacific Co.). R R Gaz-Jan. 3 1500 w.

3433. Locomotive Expenses vs. Cost of Transportation (Abstract, with comment on a paper before the Western Railway Club, stating that the important question is how much does haulage cost per ton mile, not how much does it cost to run the locomotive). Ry Mas Mech-Jan. 1000 w.

3434. The High Speed Brake. From a paper by R. A. Parke Description of the operation as brought forth in a paper read before the New England Railroad Club). Ry Mas Mech-Jan. 1100 w.

†3458. The System of the Detroit Railway Company (A very fully illustrated description of a large electric railway plant). St Ry Jour-Jan. 3600 w.

†3459. Urban Growth and the Electric Railway. Louis Bell (Discussion of the effect of local railways on the value of real estate, and time saved by business people. Illustrated by a map of Boston, showing the curves of a fifteen minute and half-hour ride from business in 1888). St Ry Jour-Jan. 3800 w.

†3460. The Breakage of Street Car Wheels. R. J. McCarty (An examination into the causes for the breakage of car wheels). St Ry Jour-Jan. 1800 w.

†3461. Electric Railway Practice in the United States (An excellent monograph of present practice, well illustrated and up to date). St Ry Jour-Jan. 10400 w.

†3462. Electric Conduit Construction on Amsterdam Avenue, New York. (The line, which is the extension northward of the Third Avenue line, is now about completed. Views and drawings fully illustrate construction). St Ry Jour-Jan. 800 w.

†3464. Street Railway Roadbed. Mason D. Pratt (Illustrated descriptions of early types and patents of rail sections and splices). St Ry Jour-Jan. 1800 w.

*3481. Rail Guards (The subject is discussed editorially, and numerous examples of both wooden and iron guards given). Eng, Lond-Dec. 27. 2200 w.

3491. About wrecking Trains (Description of the wrecking service and equipment on the N. Y., N. H., & H. R. R. They get their train off in five minutes). Ry Rev-Jan. 4. 2200 w.

3501. Building Temporary Trestles Over Washouts and Burnouts). George J. Bishop (A paper prepared for the Amer. Assn. of Bridges & Buildings, but not read. The article treats of the organization and equipment required for such emergencies, with special reference to repairs of badly side washed embankments) Ry Age-Jan. 3. 3000 w.

3502. Pneumatic System of Handling Switches and Signals. (The air at 80-lbs. pressure, operated by pipes and valves, acts as the moving power. The valves and switch are illustrated by cuts and switch indication fully explained). Ry Age-Jan. 3. Serial. 1st part. 1100 w.

3524. What Next in Electric Railway Work? J. R. Cravath (Read before the Chicago Elec. Assn. A brief outline of some of the new engineering features that will probably enter into electric railway work in the immediate future). Elec Rev-Jan. 8. Serial. 1st part. 2200 w.

3529. Air Brakes (Two papers, with discussion, read before the New England Railroad Club, on air-brake equipment of passenger and freight cars. The papers are practical in their treatment and cover the subject well). R R Gaz-Dec. 13 6500 w.

3530. Performance of Compound Locomotives (Tabular statement of the principal points of interest in a number of simple and compound engines relative to long service and fuel consumption). R R Gaz-Dec. 13. 500 w.

3534. Wide Fireboxes for Locomotives (A discussion of the paper on "Wide Firebox Locomotive Boilers," read before the Western Railway Club). Eng News-Dec 12. 3500 w.

3540. Railroad Grade Crossings Under the Illinois Law (The practical working of various Illinois laws). R R Gaz-Jan 10. 2500 w.

3541. Locomotive Service. J. H. M'Connell (A paper read before the Western Railway Club, on working efficiency, tonnage rates, performance and cost, with suggestions for improvements). R R Gaz-Jan. 10. 2000 w.

3543. A Railway Division and Its Work (An article that should be read by every railroad manager. The character of the road is fully described; the organization of the departments, their equipment, and operation are given in detail. This is an actual case in the N. Y., L. E. & W. R. R. on its Delaware division). Eng News-Jan. 9. 8000 w.

3544. The Division Superintendent and His Work (Defining the duties and responsibilities of a railroad superintendent, and commenting on an address before the Amer. Railway Assn., by Col. H. S. Haines, who says that if a man is held responsible, he should certainly have control of the work). Eng News-Jan. 9. 1800 w.

3545. The Passaic and Newark Electric Railway (A well illustrated description). Eng News-Jan. 9. 1300 w.

SCIENTIFIC MISCELLANY

Preservation and Arrangement of Current Special Trade Literature.

PROBABLY most engineers have felt the want of a system whereby the valuable part of the current trade literature, such as catalogues, circulars, price-lists, reports, tables of data, etc., might be permanently retained and arranged for convenient reference. Mr. William H. Bryan appears to have worked out this problem so satisfactorily that we present an abstract of an illustrated article in *Journal of Engineering Societies* for November wherein he describes it. He says with reference to this class of literature that the want of an efficient system "prevents any considerable use being made of it, and greatly reduces—if it does not wholly destroy—its value. Very early in my own experience I found that I must adopt a system which would make it possible to put my hands immediately upon all the accumulated matter upon any one of many different subjects. As other engineers have no doubt been confronted with the same difficulties, I have thought it might be of interest to explain the solution which I finally reached.

"Any satisfactory plan must, of necessity, be simple in design and arrangement, complete, occupy little space, and not be expensive in first cost. It should be possible to remove and replace any single pamphlet without disturbing the others. Above all, the system must be so nearly 'automatic' as to require the minimum of thought and labor to maintain it at its highest efficiency."

After trying various methods and finding them all inadequate, Mr. Bryan found it necessary to change the last system adopted, in order to get the full value of the matter he had collected for years, embracing over one hundred subjects. Referring to the illustrations, Figs. 1 and 2, the method will be easily understood from Mr. Bryan's description quoted below.

"The accompanying sketch, Fig. 1, indicates my solution of the difficulty. I had a case of shelves made, of shape and dimensions shown. There are five shelves, each forty inches wide and thirteen inches high in the clear. The ends, tops, and facings of the shelves are of antique oak, the rest of the case being of ordinary material—poplar, I believe. The case is on rollers.

"I then ordered five dozen 'perfection' letter-file cases of standard size, which is 12″×10½×2¾ deep (Fig. 2). I had partitions placed in forty of them, giving me eighty divisions of about 1⅜″ depth, for

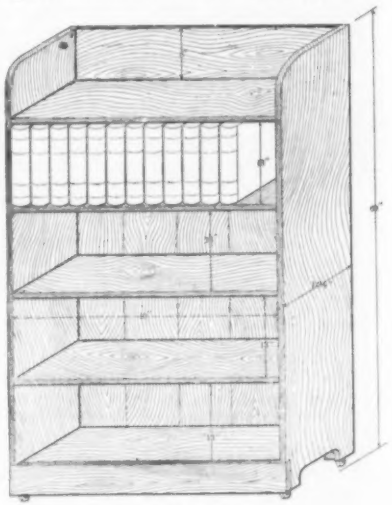


FIG. 1.

ordinary use, the remaining twenty being full depth and intended for those subjects on which an unusual amount of matter had or might be accumulated. The cases are sufficiently large to receive any of the standard sizes of catalogues or pamphlets. In fact, there are but few odds and ends of eccentric shape that cannot be handled. The case of shelves cost $7.00, and the letter files $16.50, being $2.50 per dozen, with an extra charge of 10 cents per case for the partitions,—a total of $23.50.

"Each of the five shelves contains twelve filing cases, with three or four inches of space to permit easy handling, as well as some overcrowding of cases, or even an additional case on each shelf.

"Each of the one hundred divisions is numbered, and bears also a label indicating its contents. In my desk I keep an index, which is a copy of the labels on the individual cases. When the literature is received, it is first examined to determine whether it appears worthy of preservation. If worth saving, it is placed temporarily in a convenient drawer in my desk. When this drawer becomes filled,—which, in my own case, often happens two or three

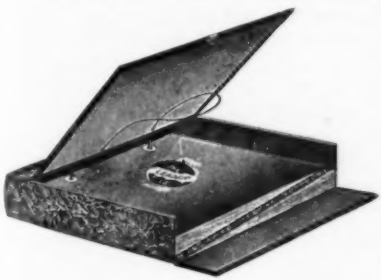


FIG. 2.

times a month,—all the accumulated matter is gone over again and examined more carefully. On each pamphlet which I decide to preserve, I mark the number of the filing division into which it is to go. The whole is then turned over to an assistant, who files the pamphlets in their places.

"When I desire to look up on any particular subject, I turn my index, I ascertain the number of the division, and request an assistant to bring me the proper case. As my system of indexing is alphabetical, however, it is frequently quite as convenient to go directly to the shelves and pick out the case desired. If a single pamphlet is being consulted, it can, when I am through with it, be placed temporarily in the receiving drawer, if there is not time enough to file it away permanently.

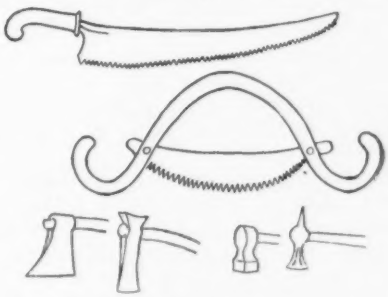
"In practice, I have found that still further division is necessary on some subjects. To carry these out, I use large manilla envelopes, each bearing a subheading corresponding to the branch of the subject it serves.

"To carry out the system in its best shape, it is necessary to go through the cases carefully every year or two, making provision for new subjects which have arisen, relieving over-loaded divisions, and weeding out duplicates and matter which has become antiquated or is of doubtful value.

"The system represents an investment of but $23.50, but its value to me is many times that amount. If I include its contents, I can hardly place a value on it, as much of the matter could not be replaced. I can assure you that the ability to put my hands at once upon all the matter of this character which I have accumulated for years, on over one hundred subjects, is a profound satisfaction, and I feel that I have mastered the pamphlet-filing problem for some years to come at least."

Iron Working in Ancient Egypt.

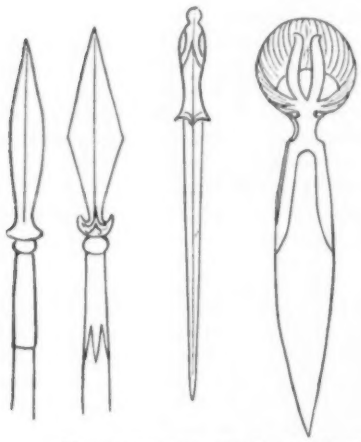
THAT writers upon metallurgic arts who have assumed that working in iron was comparatively unknown to the ancient Egyptians (and there are many, many such writers) are wholly in error in this is proved by an article in *Industries and Iron* (Dec. 13). Until recently some authors claimed that iron was a metal practically unknown



—SAWS, HAMMERS, AND AXES.

to Egyptian artificers, although their skill in working other metals was fully acknowledged. The truth must have been the very opposite of this view, as is evidenced from remains of iron works discovered during excavations in the valley of the Nile, and the unearthing of many iron im-

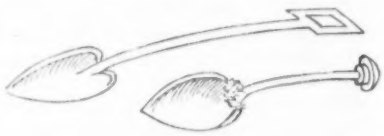
plements of war and of the arts of peace which evince a skill in fashioning iron of no mean order. Out of a large number of illustrations of iron articles discovered in a more or less preserved condition, we have selected only four groups. To these must be added agricultural implements in variety, such as ploughs, hoes, reaping-hooks, etc.; also other domestic articles,



—KNIVES, DAGGERS, AND JAVELIN HEADS.

and even an iron chariot. It has been popularly supposed that iron ploughs are of modern origin; but the ancient Egyptian plough comprises every essential of a modern iron plough, except a wheel on the beam for gaging depth of furrows and a coulter for cutting tough turf in sod-land.

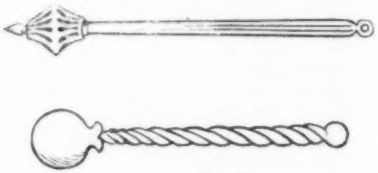
"Although the public museums throughout the civilized world have only a meager collection of the products of this kind of Egyptian craftsmanship, the country itself abounds in proofs that iron working was one of the most important industries of its earliest known inhabitants. Some of the remains of the great iron works of the Pharaohs show how systematically and on what an extensive scale this industry was carried out. Within the area of these mines and smelting furnaces the remnants of elaborate fortifications for the protection of the workmen have been discovered, as well as barracks for the accommodation of soldiers, who in those times fulfilled the double function of being military protectors of the miners, and, at the same time, their slave driving masters. Records, too,



—SPOONS.

of these mining operations were kept on enormous slabs of stone, engraved by successive generations of the Pharaohs. Many of these hieroglyphical writings are still visible, and it is supposed that, if they could be clearly deciphered, much information might be obtained about the history of Egyptian mining and metallurgy.

"Beneath the ruins of other places somewhat similar inscriptions have been unearthed, but, as these are often on less enduring plates of metal, their purport is still a matter of conjecture. Where such 'finds' are made, however, it is not unusual to meet with the remains of other things of interest. Agricultural implements, for instance, made of iron, have been brought to light in the vicinity of such slabs. These sketches represent the originals largely

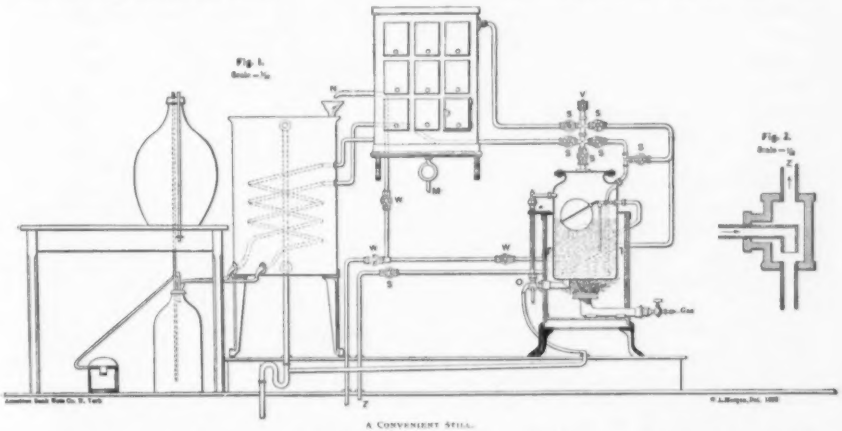


—MACES.

'restored,'—from drawings found at Thebes,—their condition, when dug up, being merely fragmentary. Yet the lion in bronze which stood upon the spot from whence these were taken has for three thousand years scathelessly resisted all the atmospheric influences which were so destructive to them. In fact, the remarkable manner in which bronzes have maintained their preservation, whilst the ironwork has so generally corroded into a mere crumble of rust, or disappeared altogether, is the only explanation of the curious paucity of iron

relics which we possess of the ancient Egyptians.

"It must be admitted that their processes for extracting iron from the ore do not appear to have been of a very superior order, because the vast heaps of slag that are found in the iron-mining localities of Egypt are said to contain from thirty to fifty per cent. of iron. This was about the proportion of 'waste'—it must not be forgotten—found in our own slag up to the beginning of the present century, when fortunes were made by the invention of new methods of converting it into serviceable metal. It has, therefore, been said that fortunes probably await those also who have enterprise enough to apply this process of refinement to the waste stuff lying about the gold mines of Egypt, whether they be iron, silver, or gold."



A CONVENIENT STILL.

A Convenient Laboratory Still.

THE still illustrated in the engraving herewith was designed by Professor Charles E. Wait, and is illustrated and described in the December number of *The Journal of the American Chemical Society*, from which we have prepared the following abstract. The still has proved eminently satisfactory in use, and it is a model piece of apparatus. The author says that, in designing this still, he proposed to utilize steam from the large boiler used for heating the building in which it was placed, and also to provide for the use of gas fuel when steam was unavailable for heating.

The still is encased in wrought iron, with a lining of asbestos, and is provided with a float which automatically regulates the flow of water from the supply-pipe. It has a capacity of seven gallons at a single charge, and is made of heavy copper, tin-lined. It has a water-gage showing the height of the water in the still; also an exit for steam, and safety-valve, *V*; an inlet for steam through a coiled perforated block-tin pipe; an outlet, *O*, for cleaning out the still; and a heavy disk gas-burner. There is a conveniently-arranged drying-oven and a large condenser, carrying two block tin worms, one direct from the still, the other from the oven, both delivering water to a carboy resting on the floor. When steam is taken from the large boiler, provision is made, by an arrangement seen in Fig. 2, located at *Z*, beneath the floor, to cleanse the steam, before it reaches the still, from the water mechanically carried into the pipes. The water returns to the boiler, while the steam passes to the still. By the arrangement of the steam-valves, *S*, it is possible to deliver the steam to the empty still, where it is again washed, and may then be passed either to the oven, or directly to the condenser, or to both. Or the steam from the boiler may be taken directly to the oven, or to the condenser, or to both. When a small quantity of steam is admitted to the still, most of the distilled water is condensed in the oven, and is caught in a

copper tin-lined vessel underneath, through the valve, *M*, a part passing to the condenser and then to the glass vessel, from which it may be forced to the carboy above. When there is no steam in the large boiler, gas is used, the water being kept in the still at a constant level by the automatic arrangement before mentioned and seen in the sketch. In this case the steam may be passed to the drying oven, or directly to the condenser, or to both.

With steam twenty-six gallons of distilled water per day is the capacity, but Professor Wait says that with gas fuel he has produced distilled water at the rate of one hundred and twenty-six gallons per day. A convenient system of piping has been arranged for supplying water to the still and condenser,—to the latter at *N*, and under control of valves, *W*, as seen in the sketch. The still and condenser are both connected with the waste, and may be emptied and cleaned when necessary. Other details of this apparatus are shown in the drawings.

Brakes and Fenders for Trolley Cars.

CONCERNING these much-debated appliances Mr. Oberlin Smith has made suggestions in *The Iron Age* (Nov. 21). To be killed out and out is, to a reasonable man, a thing not to be supremely dreaded, except that such a catastrophe may leave to those he loves a legacy of trouble; but to be half-killed—to add to the incapacity of helping others the dreadful contingency of becoming a personal burden to be carried painfully through life by those who were formerly sustained and supported—may well be dreaded, even by the bravest. In this view legs and arms become more valuable than life, and most men of independent mind would prefer death to being permanently crippled. The saving of life, regardless of injury to the limbs, appears to have been hitherto the aim of fender inventors, and Mr. Smith—justly, we think—takes the ground that this is a wrong standpoint from which to view the subject. He says:

"Among the numerous rapid-transit problems now before the public one of the most virtually interesting ones is that of brakes and fenders for street cars. Some of the reformers in this line strenuously urge the improvement of the car brake first, and there is certainly no invention more needed just now than a perfect brake,—that is, as perfect as any brake can be which will do no more than stop the wheel and allow it to slide upon the track, or nearly so. Some good device will doubtless be forthcoming, now the inventors seem to have fairly taken hold of it. Electric brakes are often mentioned, but it is evident that it will not be safe to trust to any of them, if they are dependent for their power upon the circuit alone, because of the danger of a stopping of the generator, an accidental breakage of the line, or the removal of the trolley pole from the wire. What combination will be devised to get the best results remains to be seen, but we certainly must get the momentum of these modern cars of Juggernaut under the greatest measure of control, and that with the utmost rapidity of action possible. The fender problem is a vastly more difficult one, and does not seem to have been attacked from the proper standpoint by most of the numerous fender inventors, many of whom seem, judging by their works, to regard a street car as moving in an absolute plane over a level floor. They, moreover, even where the streets are reasonably smooth, seem to provide only for the body of the victim, without regarding his arms and legs, treating him just as if he were a barrel of sugar or a bag of flour. They seem to forget that in many accidents a man or a child may fall with toes or fingers outstretched toward the approaching car. In such a case a set of finger points, from a quarter to a half an inch thick, buried perhaps in interstices between cobble stones, do not form a very large abutment for any kind of a fender to strike against with a view to absolute removal. The result is that any wedge-shaped part of a human body, such as the limbs referred to, is almost sure to raise up any sort of a fender, thus grinding the victim more surely to his death.

"It would seem, therefore, that the forward part of any such life-saving device

must run its chances of being able to occasionally strike a person so as to pick him up and give him a free ride, or to push him off sideways. In the event of a failure to do this, it should absolutely get up out of his way, so to speak, without bruising him, and leave him to the tender mercies of some kind of a guard further back, which should at all hazards prevent the wheels rolling over him. On a level floor this would be easy enough, as such a guard would extend entirely across the car, and almost touch the floor by means of any preliminary action occurring at the front fender. Unfortunately this happy result cannot be well secured on rough streets, but our city governments should absolutely insist upon wheel guards running not more than a quarter or, at most, a half an inch above the surface of the rails secured positively from rising, and attached to the trunk close in front of each and every wheel. How close this can practically be run to the pavement between the rails depends upon the particular nature of each street surface in question; but that it should be very low and very rigid goes without saying, even at the risk of its occasionally striking the ground and impeding the car. This would sometimes grind up fingers and arms, but could hardly run over and crush the whole body. Whether the obvious plan can be accomplished of running over passengers without hurting them by leaving a high enough clear space under the axles and motors for them to lie in comfortably and gaze up to the floor of the car is very questionable. It certainly cannot be done without a change of design. If this could come to pass, it would be necessary to guard only a few inches in width in front of the wheel itself, in which case the guard could almost touch the rail."

Globular Lightning.

MOST of the observations of that rare atmospheric phenomenon known as globular lightning have been made by rude men, without training in scientific observations, and without skill to describe accurately that which they actually saw. Exaggeration has doubtless often colored reports of such occurrences. An account of an incident witnessed by Prof. O. C. Marsh, of Yale University, published in the *American Journal of Science* for January, will be accepted by all as free from the defects named, and, though brief, is of scientific interest. Professor Marsh writes:

"On Tuesday, July 23, 1878, I was on board a large yacht at anchor in the harbor of Southampton, England. About two o'clock in the afternoon, when we were about to sail, a violent thunderstorm came up from the west, and, as it passed over Southampton, several bolts descended, one of which, as I afterwards learned, struck a church. As the first drops of rain came down on the yacht, I was standing in the after companion-way, looking forward, when my attention was attracted by a bright light apparently near the upper part of the foremast. When I first saw it distinctly, it was about half-mast high, and was falling slowly and directly toward the deck. This light was a ball of fire, a delicate rose-pink in color, pear-shaped in form, with the large end below, and appeared to be four or five inches in diameter and six or eight in length.

"When it struck the deck, about forty feet from where I was standing, there was a loud explosion, and it was some minutes before it could be ascertained what damage had resulted. The mate, who was near the mainmast, about twenty-five feet from where I stood, was knocked down, but soon recovered. The same bolt, or part of it, also passed in front of the foremast, down a windsail ventilator, into the galley, where it knocked a large tin pan from the hands of the cook, and upset things generally in the culinary department, but injured no one seriously. Of the crew some were on deck and some below, but none were really harmed, although a few were badly demoralized. A strong ozone like odor was observed immediately after the explosion, and this remained perceptible for some time.

"The officer in command of the yacht, Captain Matthews, who was forward at the time, and escaped without injury, stated that just after the stroke he saw

streaks of lightning running around on deck like snakes. I was myself only dazed for a moment by the explosion, and saw distinctly that the deck forward was illuminated with a bright confused light. The owner of the yacht, George Peabody Russell, and his other guests, had gone below when the storm began, and suffered no harm, except possibly from fright, as they were still further away from the stroke.

"As soon as the storm had passed, I made careful notes of the whole occurrence, with drawing and measurements, as I was much interested in the subject, and it was the first instance of the kind I had seen in close quarters. An inspection showed that the vessel itself had sustained no material damage; and not even permanent marks were left on the deck where the ball of fire exploded. A number of yachts were at anchor quite near our vessel at the time,—among them the white 'Sunbeam,' just home from her well-known voyage,—but we saw no indications that any of these had been struck."

THE ENGINEERING INDEX—1896.

Current Leading Articles on Various Scientific and Industrial Subjects in the American, English and British Colonial Scientific and Engineering Journals—See Introductory.

*3011. Opposition to Inventions. William C. Dodge. Eng Mag-Feb. 3000 w.

†3058. Experimental Method of Determining the Effective Centre of the Light Emitted from a Standard Photometric Burner. D. S Jacobus (Presented at the N. Y. meeting of the A. S. M. E. Describes and illustrates apparatus and photometric method employed at the Stevens Institute Department of tests, in testing car lamps). Trans Am Soc of Mech Eng-Dec. 800 w.

†3109 Abstract of Lecture Delivered before Senior Class of Stevens Institute of Technology. Coleman Sellers (Interesting and covering in popular style nearly the whole field of engineering, and stating the special educational equipment, for success in different branches of the profession). Stevens' Ind-July. 4000 w.

†3118. Corea and the Siberian Railway. M. F. A. F. (Descriptive of the country, people, towns, and interesting features). Fortnightly Rev-Dec. 6000 w.

3161. The Savoyarde—The Bell of the Church of the Sacred Heart, Paris. Ill. (From *Le Genie Civil.* An account of the founding of the largest bell in France (18 tons), and of its transportation over common roads by means of a special truck, drawn by twelve yoke of oxen. Incidentally a brief account of many other large bells is given and a description of the process of bell founding in general is also presented). Sci Am Sup-Dec. 21. 3000 w.

3163. Manufacture of Photographic Plates. From *La Nature* (Interesting illustrated description). Sci Am Sup-Dec. 21. 1400 w.

3167. Investigation of Bovine Tuberculosis, with Special Reference to its Existence in Iowa (Abstract from Bul. of Iowa Agricultural College Experiment Station giving important results and conclusions). Sci Am Sup-Dec. 21. 4500 w.

*3197. A Spherical Catenary in Stereo (Description of the properties of this curve, and a mathematical discussion of it, also description of an optical effect of the curve). Engng-Dec. 13. 700 w.

*3208. Note on a Photographic Method of Determining the Complete Motion of a Gun during Recoil Albert Cushing Crehore and George Owen Squier (Describes a method applied to the investigation named whereby any body, moving body, may be made to trace its own path mechanically, upon a surface prepared to receive and retain the trace). Ind & Ir-Dec. 13. 2500 w.

*3211. The Iron of Ancient Egypt (Proves that, contrary to general opinion, the ancient Egyptians were not unskillful iron workers. Illustrations of implements and weapons, now known to have been used by them, are given to substantiate this allegation). Ind & Ir-Dec. 13. 1300 w.

3239. A Wonderful Ruling Machine. From *N. Y. World* (Popular description of the most perfect ruling machine ever constructed for producing gratings used for decomposing light in optical investigations. It rules from 15,000 to 125,000 perfectly parallel and perfectly cut lines to the inch). Age of St-Dec. 21. 1000 w.

*3246. Rise and Fall of the Orange Industry. J. F. Richmond (The history of orange growing in Florida, with the prediction that the industry will be revived in a very few years). Chau-Jan. 2200 w.

†3252. A Convenient Still for the Laboratory. Charles E. Watt (Illustrated detailed description). Jour Am Chem Soc-Dec. 500 w.

†3256. The Relationship of the Heat of Vaporization of Gases to Their Density and also to Their Boiling Point William L. Dudley (An intricate and very able investigation, from which is deduced the law that in any homologous series the heat of vaporization in a unit of volume of the vapor, unde the same conditions as to temperature and pressure, is proportional to the density, and also to the absolute boiling point. It is predicted that when more complete data are obtained, some interesting developments in this direction may be expected). Jour Am Chem Soc-Dec. 1400 w.

*3298. The Development of Sculpture in America. William Ordway Partridge (General

We supply copies of these articles. See introductory.

remarks on the art, with a history of its development in America, giving brief accounts of some artists who have contributed to the work). Forum-Jan. 6500 w.

*3306. Chimney Felling from Aberdeen. From *Aberdeen Free Press* (Interesting description of the felling of three chimneys, 50, 110, and 175 ft. high). Arch, Lond-Dec. 20. 1100 w.

*3319. On a New Form of Lighthouse Refractor. John A. Purves (Describes a new prismatoidal lens for lighthouses, with diagrams. This lens is claimed to be more powerful and of less weight and bulk than the Fresnel). Eng, Lond-Dec. 20. 1700 w.

*3330. Pamphlet Filing William H. Bryan (Describes and illustrates a very convenient method of preserving special trade literature, such as catalogues, cards, circulars, reports of tests, etc.) Jour of Assn of Eng Soc-Nov. 1400 w.

†3362. Borchgrevink and Antarctic Exploration. A. W. Greely (A brief account of the origin of the expedition and of the important results achieved, both scientific and practical). Cent Mag-Jan. 1000 w.

†3363. The First Landing on the Antarctic Continent. Ill. C. E. Borchgrevink (An account of the recent voyage of the whaler "Antarctic"). Cent Mag-Jan. 10000 w.

†3366. Note on Globular Lightning. O. C. Marsh (A minute and extremely interesting account of an instance of this rare form of lightning, as accurately noted by a really competent observer — one of the editors of the journal quoted). Am Jour of Sci-Jan. 500 w.

†3370. Note on the Analysis of Contrast-Colors by Viewing, Through a Reflecting Tube, a Graded Series of Gray Discs, or Rings, on Colored Surfaces. Alfred M. Mayer (Important as relating to color contrasts in articles of manufacture of high grade, in which choice and arrangement of colors is involved). Am Jour of Sci-Jan. 1200 w.

†3371. A Very Simple and Accurate Cathetometer. F. L. O. Wadsworth (Illustrated detailed description of a new cathetometer, designed by the author and, which, while claimed to be equal in accuracy and convenience to the best German and English cathetometers for laboratory purposes, can be made for a cost of less than one-tenth of what the best of these instruments have hitherto cost). Am Jour of Sci-Jan. 2400 w.

†3372. Helium, Its Identification and Properties C. A. Young (Account of the discovery and identification, with what has thus far been ascertained as to its properties). Pop Sci M-Jan. 2400 w.

3437. The Cold-Storage Rooms in the Reading Terminal (Illustrated detailed description. The rooms are refrigerated by ammonia compressors, distribution of effect being by brine circulation). Eng Rec-Jan. 4. 1800 w.

*3443. The Treatment of Trades Waste. William Naylor (Abstract of a paper read before the Inst. of Civ. Engs. An interesting résumé of progress in reducing waste in a great variety of manufacturing industries). Ind & Ir-Dec. 27. 6000 w.

*3446. Megass and Refuse Furnaces. William Price Abell (An illustrated description of means and methods of using megass and other refuse as fuel and a résumé of progress in the art). Ind & Ir-Dec 27. 1800 w.

†3467. Floating Sand. An Unusual Mode of River Transportation. Frederick W. Simonds (A description of a remarkable phenomena, which has never yet received a fully acceptable explanation, but which may be more or less related with formation and obstruction of river channels). Am Geol-Jan. 2500 w.

*3470. Experiments on Wind Pressure. (An important experimental study of wind pressure upon planes with reference to the determination and measurement of the partial vacuum produced behind a flat plane by winds blowing upon its face, set at different angles with the direction of the wind. Diagrams illustrate the apparatus used and method of experimenting, and graphical representations of different effects aid in elucidating the text. Tabulated results are also presented. The results of this and kindred experiments are likely to modify existing formulæ for calculating wind strains). Engng-Dec. 27. 2200 w.

*3472. The Science and Art Department and Education (Review of the report of the Royal Commission on Secondary Education. The South Kensington influence is regarded in the report as having been deleterious to the field of school education in Britain. This view of the case, the reviewer thinks, has not been well established. On the other hand the results attained are considered as justifying the faith in the possibilities of the schools under the control of the Science and Art Department). Engng-Dec. 27. 1800 w.

†3510. Graphics of Thermodynamic Law. R. H. Thurston (An illustration of the value of the graphic method in the discussion of special thermo-dynamic problems, being the application of this method to the second form of the general equation expressing the first law of thermodynamics as formulated by Clausius and Rankine). Jour Fr Inst-Jan. 1200 w.

†3517. Energy Equivalents. Edward J. Willis (Tables whereby the labor of a great variety of engineering calculations is reduced to simple multiplication and division. The subject matter was first published in the *American Machinist*, but is here presented in tabulated form). Stevens In-Oct. 1200 w.

†3548. The Rubber Trees of British West Africa. Hawthorne Hill (A new source of rubber promising to be of great value to commerce). Ind Rub Wld-Jan. 10. 900 w.

†3549. The Rule of Thumb in the Rubber Factory. Stephen P. Sharpless (Condemning some practices of rubber manufacturers, and suggesting chemical investigation). Ind Rub Wld-Jan 10. 1000 w.

†3550. Considerations in Catalogue Making. C. D. Frost (Nine points of importance to be considered in the making of a trade catalogue). Ind Rub Wld-Jan 10. 1000 w.

NEW CATALOGUES AND TRADE PUBLICATIONS.

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Otis Allen & Son, Lowell, Mass., U. S. A.= Pamphlet, 24 pp. "The Artificial Preservation of Timber." Contains much information upon the waste of forests in America, the durability of timber of various sorts and processes for preserving timber, and, in particular, the kyanizing process carried out at the works of this firm Well illustrated in half-tint. (6) Sheets illustrating in half-tint examples of timber after use both kyanized and unkyanized, examples of engineering in which kyanized timber has been successfully applied, etc.

Brown & Sharpe Manufacturing Co., Providence, R. I., U. S. A.=Catalogue, 366 pp. Describing and illustrating cutters, gears, gages, micrometers, callipers, etc., etc. Darling, Brown & Sharpe, U. S. standard rules, cast steel try-squares; American standard wire gage, and a variety of tools for accurate measurements. To the above have been added in 1895 a line of universal milling machines; power lapping and automatic gear cutting machines; gear rim milling machine, screw machines with automatic chuck and wire feed; polishing and finishing machine with brake; case-hardening and hard-coal tempering furnaces; hand milling, and taper milling attachments for milling machines; driving fixture for high speed milling attachments; single dial index centers of different sizes; flanged vises; milling machine screw arbors; centrifugal water pump; geared water pump; and new sets of tools for milling machines. This is a notable advance of lines for a single year. Formulas and tables of great utility and complete indexing render this one of the most valuable catalogues for the use of mechanical engineers.

The Cumberland Iron and Steel Shafting Co., Cumberland, Md., U. S. A.=Catalogue, 12 pp. Turned, ground, and highly-polished steel shafting.

Harry C. Sping, St. Louis, Mo., U. S. A.= Catalogue, 100 pp. Mill, factory, plumbers, steam and gas fitters', and engineers' supplies.

Smith and Anthony Company, Boston, New York, and Chicago, U. S. A.=(a) Catalogue, 112 pp. "Hub" stoves, ranges and furnaces; (b) catalogue of hot water heating appliances.

Automatic Circuit Breaker Co., Newago, Mich., U. S. A.=Catalogue, 28 pp, illustrating and describing automatic circuit breakers.

Cortright Metal Roofing Co., Philadelphia and Chicago, U. S. A.=Catalogue, 16 pp. Illustrates and describes metal tiles, metal slates, ornamental shingles, and roofing sundries.

Master Builders' Exchange of the City of Philadelphia.=Hand book, 304 pp.; being a catalogue of the permanent exhibition of this exchange. and containing valuable information and interesting statistics of building.

T. C. Joy & Co., Titusville, Pa., U. S. A.= Catalogue, 40 pp. Illustrates and describes radiators for hot water and steam heating.

The Ingersoll-Sergeant Drill Co., New York, U. S. A.=1895 Catalogue, No. 40, 146 pp. Describes and illustrates at length, and in detail, rock drills, stone channeling machines, quarry bars, gadders, and special quarrying machines. This catalogue and other trade publications issued by this company are among the most thorough, complete, and artistic in modern trade literature.

The Solvay Process Co., Syracuse, N. Y., U. S. A.=Pamphlet, 20 pp. The Semet Solvay retort coke ovens with recovery of by-products. Half-tint illustrations.

Sanitas Manufacturing Co., Smith & Anthony, proprietors, Boston, Mass., U. S. A.=Catalogue, 64 pp., illustrating the "Sanitas" plumbing appliances, and other plumbing specialties.

Hilles & Jones Co., Wilmington, Del., U. S. A.=Catalogue, 32 pp. Illustrating and describing a special line of machine tools for working iron, and steel plates, bars and structural shapes.

Emerson Electric Manufacturing Co., St. Louis, Mo., U. S. A.=1895 Catalogue, 42 pp., illustrating and describing electrical appliances.

A. L. Ide & Son, Springfield, Ill.=Special Catalogue. (*a*) Illustrating the "Ideal" self-oiling steam engine; (*b*) illustrating and describing the several devices used for increase of belt contact and reduction of space required for steam plants of given power, and improvement in methods of power transmission; (*c*) leaflet "out of date and up to date" bearings for engines and dynamos; (*d*) leaflet. The Ideal High Art Engines; (*e*) list of purchasers and users of 13,000 horse power developed from "Ideal" engines in the United States and foreign countries; (*f*) pamphlet, 28 pp., illustrating and describing in detail the construction of the "Ideal" engine and the self-oiling devices used therewith.

Frick Company, Waynesboro, Pa., U. S. A. =Catalogue, 216 pp. Illustrating and describing refrigerating and ice-making machinery for use in cold storage depots, packing houses, breweries, ice factories, etc. 1 to 500 tons daily capacity; direct expansion or brine system.

Electric Heat Regulator Co., Mineapolis, Minn., U. S. A.=Pamphlet, 24 pp., illustrating and describing an electric heat regulator for automatically controlling temperature, and applicable to steam, hot water, or furnace heating apparatus.

Joseph Dixon Crucible Co., Jersey City, N. J., U. S. A=Pamphlet, 16 pp. Graphite and its uses, especially in lubrication. Many examples of, and testimonials to, the value of graphite in the latter capacity are presented.

The Brown Hoisting and Conveying Co., Cleveland, Ohio, U. S. A., with branch offices at New York, Pittsburg and Chicago.=Catalogue, 83 pp. Elegantly illustrated in half-tone.

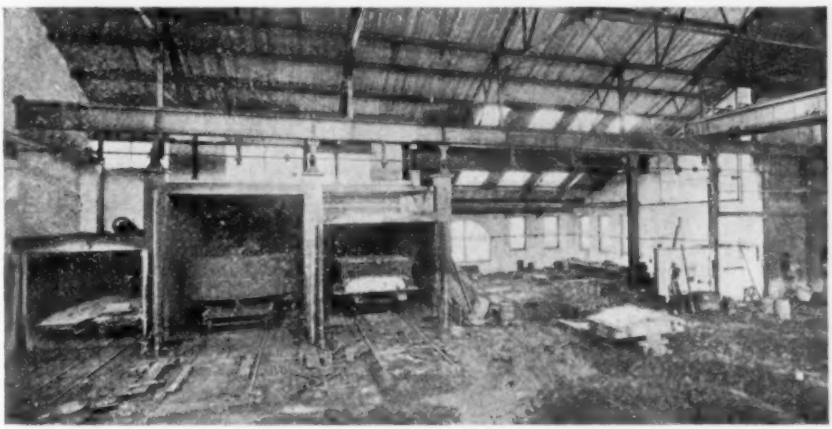
IMPROVED MACHINERY

NEW PROCESSES. NEW APPLIANCES.

The matter published in this department is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

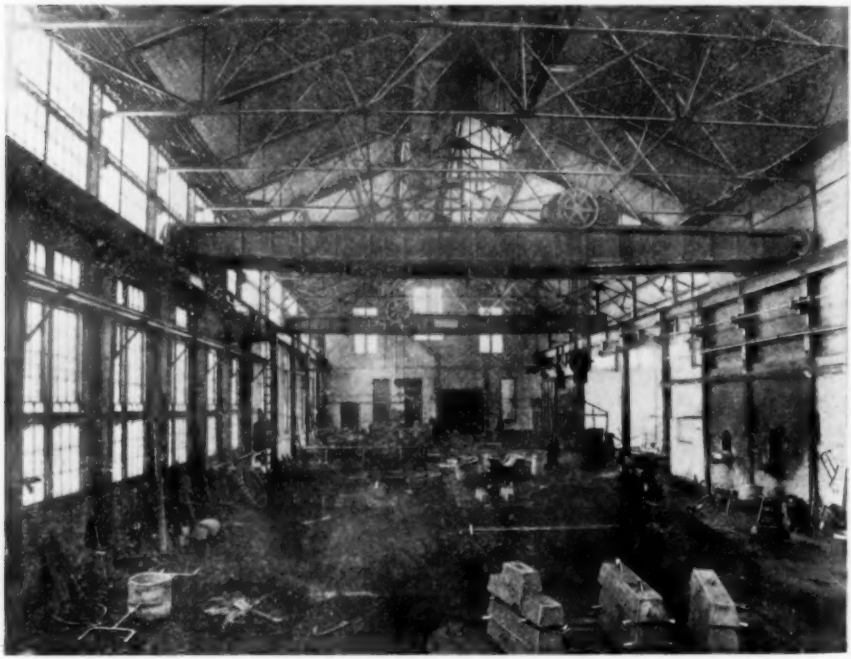
A Modern Foundry Building.

A FINE example of modern foundry construction is here illustrated. This structure was the out-growth of an old foundry which had been used for several years by the the Watts Campbell Co., Newark, N. J. Two years ago they occupied a foundry about 58′×70′, but at that time increased the size, making the old foundry about 90′ long, the new portion somewhat higher, and thus enabling them to use a traveling crane in the new portion. Having recently decided to arrange the old foundry so as to deliver the traveling crane the entire length of the building, and also to extend the old foundry on one side 50′ as a wing, the Maryland Steel Co. were invited as engineers to submit a design for adding more available room to their plant without disturbing the old walls or reducing the strength of the structure. A satisfactory design for a steel structure having been submitted, the contract for executing the work was awarded to them, and it has now been completed in a very satisfactory manner without delay to the operating of the plant.



One of the difficulties encountered was, that the walls of the old building and those of the extension on the end, varied in thickness in the line of the crane girder from 8″ to 18″; and as the traveling crane rail must be continuously straight, it necessitated the building of steel posts in the shape of the letter "T," and fastened to the old wall so as to bring the center of the crane rail over the proper position. The posts were fastened to the old wall with bolts, and set on foundations laid in cement mortar. Provision was also made for a steel post between the main building and the wing, to carry a jib crane, if necessary; thus enabling them to take the molten iron as it runs from the cupola and swing it into the wing if necessary. The size of the main foundry as now built is 176′×58′; wing 50′×50′; and cupola room 25′×40′. There are three core ovens: one 9′×18′×8′ high; one 12′×23′×13′ high; one 12′×18′×10′ high; and also one Millett core oven. There are two electric cranes traveling the entire length of the building, one of 20 tons capacity, and one of 10 tons capacity, with a lift for each crane of 20′. There is one Whiting cupola of a capacity of 10 tons per hour, and one

of a capacity of 5 tons per hour. Also a coke elevator and hydraulic lift. The cupola room has a capacity of 500 tons, the blast being provided by a Connellsville blower. The entire building is provided with electric lights, and is lighted by windows in the sides which can be opened for ventilation; also has continuous sash and glass along the sides above the track of the traveling crane, and a ventilator extending the entire length of building on top of roof which is furnished with iron louvres and interior sliding doors. The Maryland Steel Company have a large corps of engineers who have had



extensive experience in the designing and remodeling of manufacturing plants, and also a structural department fully equipped for the execution of such work.

Carbolineum or Wood Preservative.

THE Q & C Company, 703-706 Western Union Building, Chicago, Ill., is now prepared to sell what will be known as the Q & C Carbolineum or Wood Preservative. This is to a great extent, not an untried article, for it is a formula which has been used very successfully for several years, having been sold by a Buffalo party, to many railroads, steam and street, as well as to other concerns.

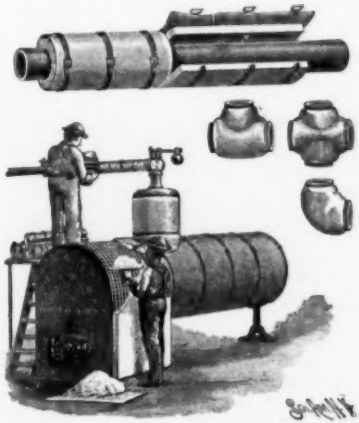
The Q & C Company, hearing of its success, made arrangements for the complete product, having had very careful tests made, that it might be adapted beyond question to our many kinds of wood and to our climate. The work of this company with the Serviss Tie Plate has brought to its attention in a very marked manner, the great need of a good wood preservative.

The uses of this preservative are many. The car builder can use it to great advantage either for car timbers, or for the ends alone, floors of stock cars, etc. Engineers can use it largely for timber used in the construction of platforms, crossings, signal boxes, and in fact wherever there is either wet or dry rot possible. It is also alleged to be a sure preventive against the teredo.

Steam Pipe and Boiler Covering.

IN the accompanying illustrations are shown the methods by which non-conductive covering is applied for purposes of insulation by the New York Fire Proof Covering Company, 121 Liberty street, New York. The material used as a non-conductor is rock wool, which is made of

feldspar and limestone, in much the same way as mineral wool. The makers state it is much superior to the latter, inasmuch as it contains no sulphur or anything that will injure iron, and presents minutely divided air spaces, whereby the covering is made very light, containing about 96 per cent. dead air. This makes a covering claimed to be undoubtedly the very best fire proof insulator for steam pipes in the market. Owing to its lightness and the superior manner in which it is constructed, it is not



PIPE AND BOILER COVERING.

affected by vibrations in the pipes, and will not sag nor powder in the wrapper.

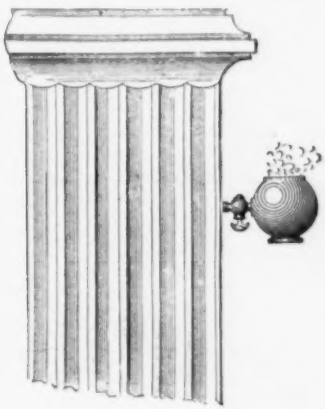
The manufacturers say that at a recent test of different coverings bought in the open market by the State College of Pennsylvania, this covering gave from 20 to 50 per cent. better results than any of the other coverings used in the test. A complete copy of this test, showing a sketch of the apparatus used, etc., can be had by anyone on application to the above company. Similarly favorable results have been obtained in more recent tests.

For boilers, domes, heaters, tanks, etc., the coverings are made in blocks from one to two inches thick, these to be covered with wire netting and a coating of rock wool cement, making a smooth, hard finish. A rock wool fire proof cement which can be mixed with a trowel and applied like mortar is provided for covering irregular shaped surfaces. The covering is in each case very simple of application, requiring no skilled labor. The saving from radiation is very great, and it is claimed that the investment will pay for itself in a few months' time. These claims are rapidly extending the sale of this excellent and convenient pipe and boiler covering.

A Good Vapor-Valve.

THE supply of a good valve to be applied to steam radiators for regulating the amount of moisture in a steam heated room, has been a desideratum. The valve herewith illustrated appears to fill the bill of requirements, being durable, convenient in use, and efficient for the desired purpose. It has been placed on the market by the Vapor Valve Manufacturing Company, 16 Murray Street, New York, of which company Mr. George Henry Bell (a leading man in the valve interest) is president.

This vapor-valve is designed to take the place of ordinary radiator air-cocks, but in addition it enables occupants of steam-heated rooms and buildings to regulate perfectly the amount of moisture in the atmosphere to such a degree as will render it pleasant and sanitary for respiration. The valve in admitting steam into the



VAPOR VALVE.

room, is ingeniously prevented from hissing. By placing perfume, or a disinfectant in the cup, the air may be either perfumed or disinfected as desired. The advantage and convenience of this feature in sick-rooms will be apparent to everybody.

In construction this vapor-valve is an air cock with a bulbous shaped cup appended, the center of the cup being axial with the cock. The cup, which is open at the top only, is filled with a substance, both porous and elastic, which divides the steam and increases the area of emission as compared with the steam coming through the cock so greatly as to prevent vibration and consequent noise of the air and steam. The filling in the cup in no way interferes with the egress of air for usual requirements.

Noteworthy Exhibit of the John H. McGowan Co., Cincinnati, Ohio.

VISITORS at the Cotton States and International Exposition will recognize in the engraving, an exhibit of machinery which is characterized as being one of the attractive features in the Department of Machinery; the arrangement of the various types being such as to greatly enhance the general appearance of the display.

A special feature of this exhibit was a large compound pumping engine operating fountains in the Grand Basin (Clara Meers). To any one conversant with the many designs of compound pumping engines this must have impressed him with the idea that it is of the very highest grade, bearing evidence throughout its detail of superior mechanical construction. This engine is provided with all the improved features embodied in pumps of this type and is equipped with adjustments to take up wear on all working parts. The McGowan patent non-slippage Valve Seat with which this machine is fitted is a very interesting device in itself; through its use (the inventors claim) a saving of from 10 to 25% over the type in general use.

In their other types of pumping machinery of both the single cylinder and duplex patterns the critic will observe valuable improvements, which have been incorporated in their designs since our great World's Fair, all of which tends to prove the rapid advancement in a line of engineering which was presumed to have reached its highest degree of perfection.

In concluding comments on this display it may be said their Deep Well Engine was also of much interest. While its general appearance is much the same as those of other makers, the controlling devices employed permit absolute regulation of piston speed to conform to all conditions of well supply and to the elevation or point of discharge, as was shown by its operation under these various conditions.

The entire exhibit was operative; the smaller machines being supplied with air from one of their compressors which also furnished power to the Exposition Company.

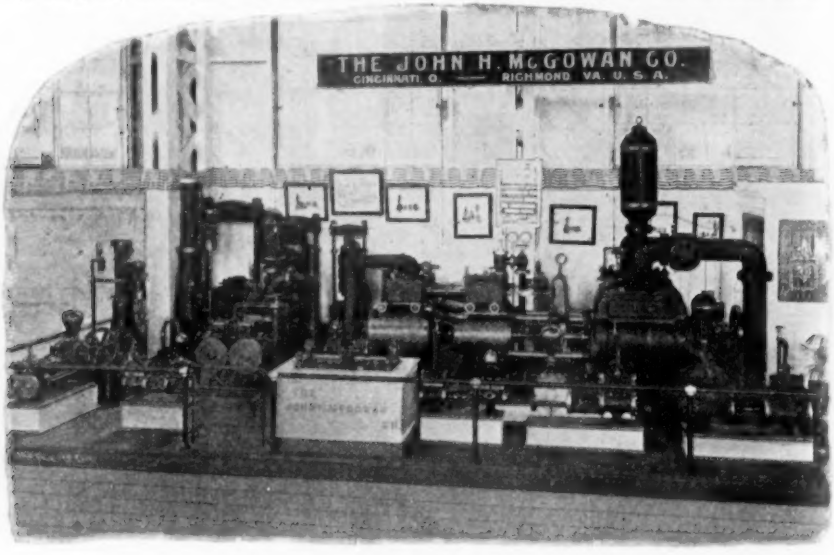


EXHIBIT AT ATLANTA.

Improved Universal Milling Machine.

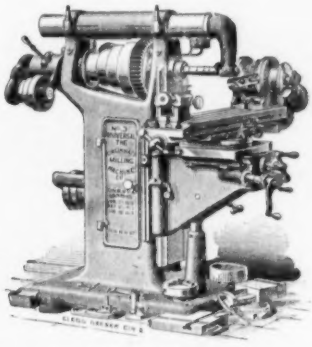
THE design of a new line of universal tool-room milling machines, embodying new ideas in construction, is shown in the illustration, the machine being an 1895 product of the Cincinnati Milling Machine Co. Spindle power and strength of feed are important features in which the makers have striven for excellence.

The adjustments of the machine require the least time from the operator. The shaft for vertical motion is at an oblique angle and carries a clutch crank. Permanent handles on screws are supplied for cross and longitudinal table adjust-

ment. The operator controls all adjustments without changing position or shifting handles. Two adjustments may be made simultaneously. The cylindrical overhanging arm, when in position, is rigidly clamped at two points, and is provided with an adjustable phosphor bronze bushing, forming a perfect cylindrical support for the end of the cutter arbor.

Through very simple mechanism twelve changes in the feed, progressing uniformly, are obtained for every spindle speed. A pointer on the lever indicates the feed on a dial. Throwing this lever from one side to the other doubles the feed or reduces it one-half, without removing belts or pulleys,—a valuable feature in milling work that requires both a rough and finishing cut.

There is also an automatic cross motion in line with spindle, and an automatic vertical feed can be supplied. In the larger machines the screw for vertical motion is provided with anti-friction



MILLING MACHINE.

bearings. All feeds are automatically tripped, and so constructed as to permit a further adjustment of table by hand, without releasing it from its original position.

The circular form of the swiveling carriage permits the cutting of spirals or doing any work requiring the setting of the table at an angle. The swiveling carriage need not be drawn out from the face of the column as far as when it is square, and a shorter cutter arbor can be used. The swiveling carriage always bears full on the slide on top of the knee, at any angle the table may be set. The spindles are of crucible steel and hollow. The front bearing is of solid cast iron, lined with babbitt.

The indexing head permits the swiveling block carrying the spindle to make a complete revolution. This gives the operator choice as to character of cut, and permits some cuts to be taken without tendency to dig into the work. Also right-hand and left-hand cuts can be taken without change of cutter. The block carrying the spindle is contained within its support, and the spindle can be locked while a cut is being taken, relieving the mechanism from strain. This spindle has a cup shaped dial for rapid indexing. The tail stock center bar is raised and lowered by a rack and pinion for taper work, and there are two centers formed upon the bar, one for the smallest work, the other for larger work. A full set of change gears for cutting spirals is furnished.

Two sizes of this machine are built, No. 3 size has a length of platen feed of 27 inches ; cross motion in line with spindle 7½ inches ; vertical range 19 inches ; working surface of platen 43×9½ inches ; swing on index centers, 21×21 inches ; range of feed per revolution of spindle, .006 inch to .15 inch. Its net weight is 2800 pounds.

The makers, the Cincinnati Milling Machine Co., of Cincinnati, have been very busy throughout the year. The demands upon them have required the erection of an addition to their building, and the experience of representative shops with their late improvements gives promise that the added capacity will be likewise taxed to its full extent.

Vicars' Automatic Mechanical Stokers.

RECENT municipal legislation respecting the discharge of smoke from factory chimneys in Pittsburgh, has served to attract attention to the all important, though strangely neglected, question of practicable methods of abating the smoke nuisance.

Economy of fuel is usually carefully considered in the construction of engines and boilers, but the complete consumption of smoke has hitherto been regarded as impracticable, and although various devices—such as mechanical stokers—have been tried in times past, imperfect mechanism prevented their general adoption. The formation of clinker and rapid destruction of grate bars were formidable obstacles to overcome in systems of stoking by machinery.

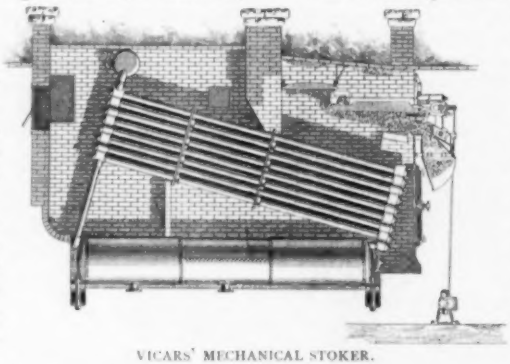
Messrs. T. & T. Vicars of Lancashire, Eng., succeeded in overcoming these difficulties and they have so fully established their claims that they have already made about 4000 installations of their Automatic Mechanical Stokers in England and Great Britain.

A few years ago the firm of Wm. Sellers & Co. Incorp. of Philadelphia, wishing to investi-

gate this subject fully, imported one of the Vicars' stoking plants and a skilled man supervised its operation during an exhaustive series of tests, extending over a period of many months, in which all kinds of fuel, including the poorest quality of bituminous slack as well as better grades of hard and soft coal were used.

The extremely satisfactory results of these tests caused the Sellers Company to secure from the patentees the exclusive right for the manufacture and sale of the stokers in the United States. In the course of the tests sundry improvements in mechanical details suggested themselves, rendering the stokers, as now made, more perfectly adapted to American practice.

It would not be practicable within the brief compass of this paper to describe the tests or even the apparatus in detail, descriptive pamphlets relating thereto may be obtained, by those interested in the subject, from the manufacturers in Philadelphia.



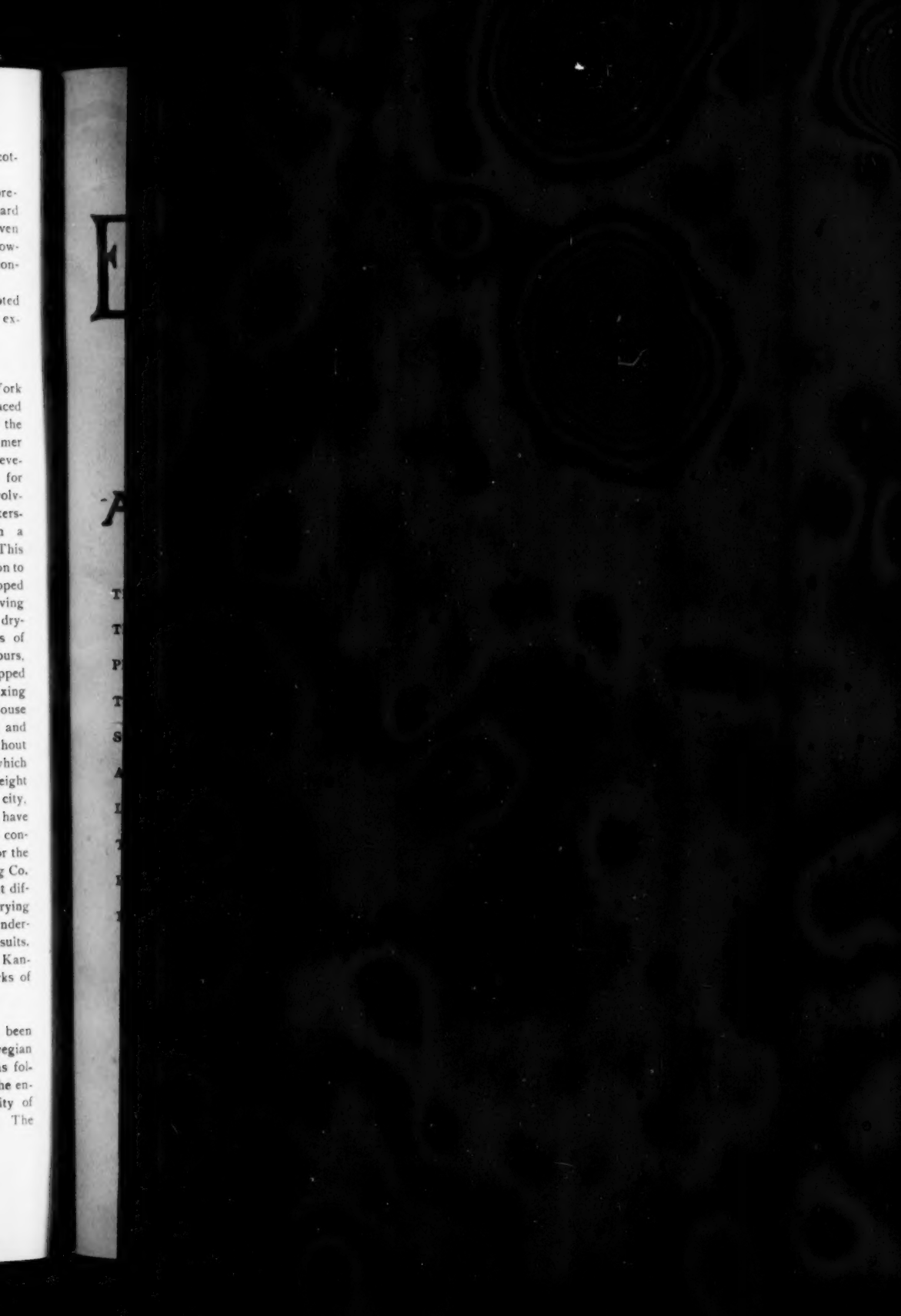
VICARS' MECHANICAL STOKER.

In brief, the stoker consists of a hopper from which the fuel is fed into the furnace, being gradually pushed forward by reciprocating plungers, into the fire place, whence it falls on the grate bars—which also have a reciprocating motion—carrying the burning mass gradually forward until it falls into a combustion chamber which so thoroughly consumes the coal that an analysis of the ash reveals almost no carbon. As the furnace doors are rarely opened under this feeding system sudden cooling and consequent drop of steam pressure in the gauge is unknown; the fuel is spread upon the grate bars in an even thin layer, and practically all of the smoke is consumed, the only time when smoke issues from the chimney is at long intervals when raking is desirable. The standard "Treatise on Steam Engines and Boilers," by Daniel Kinnear Clark, M. Inst. C. E., &c., &c., contains an interesting description of the Vicars' stokers and additional testimony in the shape of tabulated tests may be found in the "Text Book on Steam and Steam Engines," published in 1892 by Prof. Andrew Jamieson, F. R. S., M. I. C. E., &c., Professor of Engineering at the Glasgow and West Coast of Scotland Technical College.

An official report on Black Coal Smoke presented in 1892 to the "Local Government Board and to the Secretary of Scotland" gives even fuller details of a surprising character showing the economy of operation of this smoke consuming appliance.

The illustration shows the appliance adapted to the Babcock & Wilcox or other types of externally fired boilers.

A New Departure.

"THE Barber Asphalt Paving Co., New York City, have placed contract with the F. D. Cummer Son Co., of Cleveland, Ohio, for one of its revolving sand heaters mounted on a railroad car. This car, in addition to being equipped with dryer having capacityfor drying 100 tons of sand in 10 hours, is also equipped with engine, elevators, sand screen, and mixing platform. The car is to have Westinghouse air brakes and patent automatic couplers, and to be constructed so as to withstand, without injury, the usual knocks and shocks to which it will be subjected as part of an ordinary freight train. This car will be shipped from city to city, wherever the Barber Asphalt Paving Co. have contracts for paving. This Cleveland concern is also building a dryer and heater for the Omaha works of the Barber Asphalt Paving Co. The Cummer Company manufacture eight different styles of dryers, applicable to the drying of every material that has to be dried, understand their business and guarantee results. Among other sales is a garbage dryer for Kansas City, which is in operation at the works of the Kansas City Fertilizer Co."

A NEW ice-breaking steamer has just been supplied to the port of Libau by a Norwegian shipbuilding firm. Its dimensions are as follows: Length, 135 ft.; breadth, 35 ft.; the engine, which is a compound, has a capacity of 760 horse-power; speed about 12½ knots. The cost has been about 17,200*l*.